Chlamydia Risk Factors in Female Prisoners

by
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ABSTRACT

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Objectives: The purpose of the study was to better understand the demographic and behavioral risk factors related to Chlamydia infection in female correctional settings.

Methods: A pilot cross-sectional study was conducted on screening data collected from 194 females newly incarcerated between November 2009 and March 2010 at George W. Hill Correctional Facility in Delaware County, Pennsylvania. Univariate and multivariate analyses were performed to assess the associations among risk factors.

Results: Previous drug use was significantly associated with history of Chlamydia after adjusting for age and previous STD infections (adjusted odds ratio [OR] = 6.996, 95% confidence interval [CI] = 2.221 – 22.040). In addition, previous drug use was significantly associated with history of STDs after adjusting for age (OR = 13.531, CI = 3.725 – 49.509).

Conclusions: Previous substance use is a strong behavioral indicator for Chlamydia and other STD infections in female prisoners. The information obtained on drug use can be used as a tool to efficiently target the population in need across correctional settings. Further investigation with increased sample size, improved data quality, and additional positivity results is critical to better understanding the risk factors associated with incarcerated females at this facility.

CHLAMYDIA RISK FACTORS IN FEMALE PRISONERS

INTRODUCTION

Although female detainees have been identified as a high-risk group for Chlamydia infection (Miranda et al., 2000), insufficient public attention has been given toward addressing the health needs in this population. Limited knowledge on characteristics and risk factors of female prisoners exists to provide proper guidance in developing suitable prevention and treatment programs throughout correctional facilities across regions (Bernstein et al., 2006). As a result, screening programs are often inconsistent, or in some cases nonexistent, throughout multiple federal, state, and local prisons detaining female prisoners (Lofy et al., 2005). Now more than ever, increased knowledge about characteristics of incarcerated females has become critical in obtaining public acknowledgment on the necessity of establishing reliable Chlamydia screening programs throughout prisons.

In order to develop a better understanding of the underlying risk factors for Chlamydia in correctional settings, information regarding demographic and behavioral characteristics was collected from female detainees participating in the Chlamydia screening program at George W. Hill Correctional Facility in Delaware County, Pennsylvania. This facility has recently established a Chlamydia and Gonorrhea screening program for females entering incarceration and has been collecting data on demographic and behavioral risk factors since November 2009. The main objectives of the this pilot research were to (1) determine the positivity rate of Chlamydia in this population, and (2) identify the risk factors associated with Chlamydia positivity in female detainees. Despite several analytical challenges due to inadequate sample size, the study provided valuable findings and numerous useful insights into the distinctive

characteristics of the subjects, as well as issues that must be considered critically when investigating this population.

BACKGROUND

Chlamydia is a sexually transmitted disease (STD) caused by the bacterium known as *Chlamydia trachomatis* (Centers for Disease Control and Prevention [CDC], 2007). It is commonly known as the "silent" disease due to its asymptomatic nature that leaves about 75 percent of women unaware of their infection status (CDC, 2007). If left untreated, Chlamydia infections in the cervix can lead to numerous long-term conditions including chronic pelvic pain, infertility, ectopic pregnancy and pelvic inflammatory disease (Mertz et al., 2002). Moreover, Chlamydia has also been found to elevate risks for HIV and cervical cancer (Joesoef et al., 2009). Currently, Chlamydia is the most frequently reported STD in the United States (Lofy et al., 2005). In 2003, approximately 900,000 cases were reported to the Centers for Disease Control and Prevention (CDC), demonstrating an estimated cumulative incidence of about 300 cases per population of 100,000 each year (Lofy et al., 2005). Chlamydia infection rate has been found to be the highest in younger females, particularly in adolescents 15 to 19 years of age (Lofy et al., 2005). The estimated annual cumulative incidence in this population exceeds 2,500 cases per 100,000 (Lofy et al., 2005).

The burden of Chlamydia has been found to be heavier in prison populations across the country, especially in female detainees (Miranda et al., 2000). Research has shown that female prisoners have a higher Chlamydia infection rate compared to male prisoners (Joesoef et al., 2009). In addition, a CDC report has indicated that approximately 27 percent of women in prison are infected with Chlamydia (Clarke et al., 2006), substantially exceeding the estimated positivity rate of 0.58 percent in the general female population (CDC, 2009). Numerous studies

have also confirmed this burden of Chlamydia by discovering the infection rates ranging from 7 to 27 percent across diverse correctional settings (Bernstein et al., 2006). Challenges in detecting Chlamydia due to its asymptomatic nature (Joesoef et al., 2009) only suggest that the actual burden of the disease is likely to be heavier than what is observed.

Female Population in Correctional Settings

Despite accounting for only a small percentage of the total inmate population in the United States, the number of female detainees has been increasing steadily over the past few decades (Newman et al., 2003). The annual growth rate for female inmates has averaged approximately 7.5 percent from 1990 to 2001, compared to 5.7 percent in male inmates (De Ravello et al., 2005). As of June 2008, approximately 207,700 women were incarcerated nationwide, comprising nearly 10 percent of the total U.S. prison population (Women in Prison Project, 2009). Furthermore, the number of incarcerated women across the country increased by 203 percent from 1995 to 2008 (Women in Prison Project, 2009). Recent studies have indicated that one in every 89 women is under correctional supervision (Women in Prison Project, 2009). This dramatic increase in the female inmate population has amplified the burden of Chlamydia across federal, state, and local correctional facilities.

The health outcomes of female detainees are directly linked to the public, since inmates constantly flow in to and out of prisons (Conklin et al., 2000). It is estimated that over 7.2 million detainees are released into the community each year (Hammett et al., 2002). In addition, over two-thirds of released inmates are rearrested within three years according to the estimate by the federal government (Women in Prison Project, 2009). This constant flow of inmates inevitably leads to numerous difficulties in proper detection and treatment of Chlamydia in correctional settings, as women testing positive for Chlamydia in prison often leave prior to

obtaining screening results, follow-up counseling, or medical treatment (Jacob Arriola et al., 2001). Studies show that among the facilities that do provide Chlamydia screening programs, less than half of infected detainees are treated (Bernstein et al., 2006), demonstrating challenges in running cost-efficient prevention programs that would ensure treatment of all Chlamydia positive inmates who are detected. Consequently, the remaining half who have not been treated leave the facility with potential to spread the infection to the rest of the community (Conklin et al., 2000).

Common Characteristics of Female Prisoners

Incarcerated females are often members of racial and ethnic minorities and younger than 35 years of age (Barry et al., 2009). It is estimated that African American women are incarcerated at three times the rate of Caucasian women, while Latina women are incarcerated at approximately 1.6 times the rate of Caucasian women (Women in Prison Project, 2009). Roughly 65 percent of women in prison are incarcerated for offenses related to drug use, property or public order violation (Women in Prison Project, 2009). Incarcerated women are more likely to report risky sexual behaviors including multiple sex partners, inconsistent contraceptive use, and commercial sex work (Joesoef et al., 2009). In addition, about 37 percent of female inmates report having been sexually assaulted (Mertz et al., 2002).

Approximately five percent of women across correctional settings nationwide report having been pregnant at the time of incarceration (Women in Prison Project, 2009). Over 50 percent of inmates report drug usage within 30 days before entering prison (Mertz et al., 2002), and these inmates are also more likely to have shared needles with other substance users (Conklin et al., 2000). Most inmates tend to have had little or no education (Conklin et al., 2000), and many tend to be socioeconomically disadvantaged, as nearly 30 percent of women have

received public assistance prior to the incarceration. Furthermore, 37 percent of female inmates had a weekly income of less than $600 before entering prison (Women in Prison Project, 2009). Lastly, studies have found a higher prevalence of STDs in the female prison population compared to the general population (Miranda et al., 2000).

Women's Desire to Improve Health

Female detainees often have a strong desire for improving health (Conklin et al., 2000). Inmates frequently come from disadvantaged backgrounds characterized by low socioeconomic status and poor access to health care (Lofy at el., 2005). In fact, most incarcerated women are not covered under health insurance outside of prison and therefore lack screening tools and a primary care provider (Barry et al., 2009). Consequently, the prison health services are often the most comprehensive form of care these clients ever receive (Holmes et al., 1993). As can be demonstrated through numerous studies, high compliance and participation rates witnessed in STD screening and treatment programs in the absence of extra incentives signify the inmates' willingness to utilize the health care services provided in the facilities, and hence represent a unique opportunity for an effective, cost-efficient public health intervention toward this population (Miranda et al., 2000).

Prevalence of Chlamydia

Numerous studies have identified the female inmate population as a high-risk group for Chlamydia. In a study conducted by Holmes et al. (1993) in a New York City jail, 27 percent of 101 female prisoners tested for *Chlamydia trachomatis* culture yielded positive results (95% confidence interval [CI] = 18% – 36%). Lofy et al. (2005) performed 3,593 tests for Chlamydia at four juvenile detention centers in Washington State from 1998 to 2002, where 13.7 percent of

female adolescent detainees tested positive (Range = 12.5% – 15.0%). Mertz et al. (2002) reported 15.3 to 21.5 percent positivity rate in female prisoners aged 16 to 24 years at four prisons in Illinois, Alabama and Maryland from 1998 to 2000.

Additional evidences support the high infection rates of Chlamydia across prisons, including Miranda et al. (2000) reporting 11 percent positivity rate at the Espirito Santo State Prison in Brazil in 1997 (CI = 5.4 – 16.7), Bernstein et al. (2006) reporting 8.9 percent prevalence in women aged 18 to 25 years at two women's prisons in California during 1999 (CI = 2.9% – 22.1%), and De Ravello et al. (2005) reporting 5.7 percent prevalence at the Georgia Metro State Prison from 1998 to 1999 (CI = 4.9% – 6.4%). Barry et al. (2009) found a positivity rate of 7.3 percent among female detainees in San Francisco from 1997 to 2004. Joesoef et al. (2009) found 14.3 percent prevalence in juvenile facilities and 7.5 percent positivity rate in adult prisons throughout diverse regions across the country in 2005.

The observed prevalence rates throughout the facilities are likely to be underestimated since Chlamydia is often asymptomatic (Lofy et al., 2006). In fact, it is estimated that approximately 66.7 percent of females with genital Chlamydia do not show any signs of infection (Joesoef et al., 2009). In addition, numerous facilities continue to use old screening methods with limited accuracy and sensitivity, failing to detect more cases (Bernstein et al., 2006). Furthermore, inconsistent and cost-inefficient screening programs across correctional settings are also likely to further contribute to challenges in identifying cases (Jacob Arriola et al., 2001). Despite these challenges, all studies indicate findings that concur with one another irrespective of the varying rates reflected by differences in the recruitment of participants, testing resources, and study time period: The burden of Chlamydia is heavier across correctional settings compared to the general population.

Risk Factors for Chlamydia

Infected women in prison are reported to possess distinct demographic and behavioral characteristics associated with elevated risk of Chlamydia. However, identifying these risk factors can be difficult, as can be demonstrated from findings that contradict one another. Studies often rely on interviews and surveys eliciting self-reported behaviors as the primary method of data collection, leaving room for inconsistencies in findings. Nevertheless, some of the common risk factors that have been known to promote risk for Chlamydia include higher rates of pregnancy, unprotected sex, prostitution, drug use, history of STDs (Holmes et al., 1993), and inconsistent contraceptive use (Clarke et al., 2006). Depression, homelessness, and history of sexual or physical abuse are also linked with elevated risk of Chlamydia (Lofy et al., 2005).

In a case-control study of 101 female prisoners in New York City by Holmes et al. (1993), where the inmates were tested for Chlamydia and completed a questionnaire on demographic and behavioral information, the authors found that Chlamydia positivity was associated with younger age (mean age 24.2 years in positives vs. 26.8 years in negatives, $p<0.05$), less education (odds ratio [OR] = 11.4, CI = 1.8 – 70.7), and the presence of mucopurulent cervical discharge (OR = 4.9, CI = 1.8 – 13.4). Although women who did not grant informed consent at the beginning of the study were similar to the participants, they were substantially less likely to report condom use ($p\leq0.05$), indicating a possible loss of additional cases who would have tested positive for Chlamydia.

In a cross-sectional study of incarcerated females by Mertz et al. (2002), where 5,364 women entering four prisons in Illinois, Alabama, and Maryland between July 1998 and June 2000 were offered Chlamydia and Gonorrhea screening, the authors reported results that concurred with findings of Holmes et al. in relation to age and Chlamydia positivity. It was

concluded that Chlamydia infection was significantly more common in detainees under the age of 25 years compared to those 25 years or older ($p<0.05$). On the other hand, the study lacked sufficient evidence to detect significant associations of Chlamydia with racial or ethnic background. Consequently, the authors concluded that race and ethnicity are not reliable predictors of Chlamydia infection for female prisoners.

In a case-control study of 3,593 female juveniles in Washington State from 1998 to 2002 by Lofy et al. (2005), information on female adolescent detainees' sexual risk factors was obtained through standardized questionnaires completed during routine Chlamydia screening. In contrast to findings by Mertz et al., the authors found that increased positivity was associated with nonwhite races such as African American (OR = 1.66, CI = 1.32 – 2.08), American Indian and Alaska Native (OR = 1.88, CI = 1.27 – 2.79), and Asian, Pacific Islander, and Hawaiian (OR = 1.64, CI = 1.07 – 2.54). In addition, multiple sex partners in the past 60 days (OR = 1.56, CI = 1.19 – 2.04) and previous Chlamydia infections in the past 12 months (OR = 1.87, CI = 1.45 – 2.40) were also linked to Chlamydia positivity.

In a cross-sectional study of 3,636 women entering the Georgia state prison system between January 1998 and December 1999, De Ravello et al. (2005) found higher rates of Chlamydia infection in African American inmates ($p=0.036$), supporting the findings by Lofy et al. In addition, the authors discovered that the infection rate was twice as high in detainees under 25 years of age compared to those aged 25 years or older ($p<0.001$), further supporting the work of previous studies that had identified age as a Chlamydia risk factor (De Ravello et al., 2005). These findings were once more supported in a cross-sectional study conducted by Bernstein et al. (2006), where the researchers evaluated data collected from 572 females entering 6 California prisons between January and March 1999. Although relatively small sample size limited the

statistical significance of findings, the authors nevertheless noted the increasing trend of odds ratios in the younger groups compared to the older groups as well as in the racial and ethnic minorities compared to the Caucasian group (Bernstein et al., 2006).

STUDY AIM AND SIGNIFICANCE

The overall aim of pilot this research was to test the hypotheses that were generated based on previous studies as well as the theories developed around findings from past research. The specific hypotheses to be examined were that (1) younger age is associated with increased risk of Chlamydia (Holmes et al., 1993; Mertz et al., 2002; Bernstein et al., 2006), (2) minority racial and ethnic background is positively associated with Chlamydia (De Ravello et al., 2005; Lofy et al., 2005; Barry et al., 2009), (3) substance use is associated with elevated risk of Chlamydia (Holmes et al., 1993; Miranda et al., 2000; Lofy et al., 2005), and (4) history of STDs is associated with increased risk of Chlamydia (Holmes et al., 1993; Lofy et al., 2005; Bernstein et al., 2006; Clarke et al., 2006). Based on the findings that (1) high proportion of female prisoners are pregnant (De Ravello et al., 2005; Clarke et al., 2006), and (2) promiscuous behavior increases the risk of Chlamydia infection (Lofy et al., 2005; Barry et al., 2009), additional hypotheses were formulated to test whether single marital status and positive pregnancy status are associated with increased likelihood of Chlamydia infection.

Although not all hypotheses could be tested mainly due to insufficient sample size, this research proved to be valuable in terms of not only the logistic and technical challenges it provided during the analysis stage but also the lessons that were learned from the process of addressing these difficulties. One significant aspect of this study was that it provided an important insight into potential obstacles of collecting self-reported data from the incarcerated population. It is suspected that the validity of information provided by the inmates may have

been, to a certain extent, compromised by various aspects of personal and behavioral characteristics unique to the vulnerable populations—i.e. a sense of insecurity in sharing information and motivation to provide socially desirable answers contributing to inaccurate reporting. Another significant aspect of the study is that it highlighted the need for an ensuring mechanism that would ascertain the quality of information when collecting self-reported data from vulnerable populations—i.e. anonymous screening process or robust questionnaire where inquiries are phrased differently but elicit similar responses in order to ensure reliability of the reported information.

RESEARCH DESIGN AND METHOD

Overview

A pilot cross-sectional study was conducted using data collected between November 2009 and March 2010 from a prison-based Chlamydia and Gonorrhea screening program at George W. Hill Correctional Facility in Delaware County, Pennsylvania. This facility had established a prison-based screening program in partnership with the Special Projects Department at the Family Planning Council for newly incarcerated females as part of the regional Infertility Prevention Project (IPP) initiative in November 2009.

Subjects

The study subjects consisted of 194 newly incarcerated females between ages 18 and 55 years who participated in the prison-based Chlamydia and Gonorrhea screening program at George W. Hill Correctional Facility from November 2009 to March 2010. As part of the new IPP initiative, all new inmates incarcerated for at least 14 days were asked to provide a urine specimen for screening by the facility's medical department staff. The waiting period of 14 days

was selected to sort out those not staying in the facility, thereby ensuring that all screened inmates would have adequate time to obtain test results, counseling, treatment and partner notification services. The inmates were included in the analysis if they had (1) enrolled in the screening program, (2) provided a urine sample for testing within the data collection period, and (3) answered questions regarding demographic and behavioral risk factors. For the inmates entering the facility multiple times, only the information from the first incarceration was used to remove duplicated risk factor information. All inmates with incomplete test results or missing questionnaires were also excluded from the study. At the end of March 2010, a total of 194 inmates had satisfied the requirement criteria and were enrolled in the study.

Data Collection Method and Variables

Chlamydia screening was performed at the facility-based clinic by obtaining urine specimens from the inmates, which were then sent to the laboratory for Chlamydia-culture testing. During the visit, inmates were also asked to respond to questions administered by the trained medical department staff who read out the inquiries to the inmates and recorded the information on the form. The questionnaire, called STD Intake Form and Laboratory Test Requisition, contained information on each participant's date of birth, race, ethnicity, marital status, pregnancy status, history of STDs and history of drug use. Once the test results were available, they were also recorded on the questionnaire. The completed forms were processed in the database by the medical staff and returned to the Family Planning Council for secure storage, data entry and analysis.

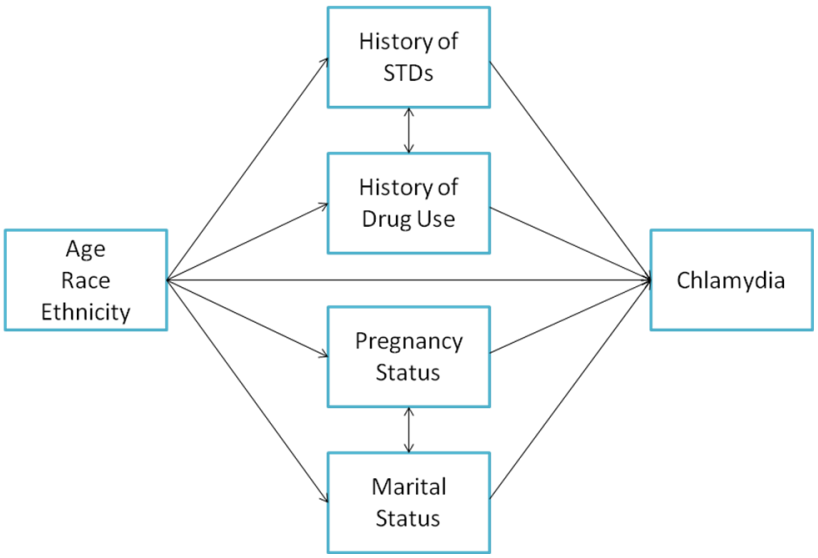
In collecting the risk factor variables, race was reported in categories consisting of White, Black, Native American, Asian, Pacific Islander, other, or multiracial; ethnicity was reported as Hispanic, non-Hispanic or unknown. Marital status was categorized into single, married,

divorced, widowed, separated, or in a committed relationship. Pregnancy status was reported as pregnant, not pregnant, or unknown. History of STDs was reported in categories consisting of Syphilis, Gonorrhea, Chlamydia, Herpes, HPV/Genital Warts, HIV, Hepatitis, unknown, or no history. For history of drug use, the subjects were asked if they had used any of the following: Methadone, Heroin, Cocaine, Alcohol, Methamphetamine, Marijuana, or club drugs such as Ecstasy or Viagra.

Theoretical Framework for the Study

The risk factor variables collected in the research were conceptualized as an interrelated network of behavioral markers leading to elevated risk for Chlamydia. The theoretical diagram describing the relationships among risk factors and Chlamydia is illustrated in Figure 1.1. Each arrow, which indicates the directionality of association, was positioned in the model based on evidence from past literature and evaluated using univariate and multivariate analyses.

Figure 1.1: Conceptual Diagram of Risk Factors for Chlamydia Infection



Demographic and behavioral characteristics are linked to form a network of risk factors contributing to Chlamydia infection.

Derived from the findings of positive association among younger age, race, ethnicity and Chlamydia infection rate (Holmes et al., 1993; Mertz et al., 2002; De Ravello et al., 2005; Lofy et al., 2005; Bernstein et al., 2006; Barry et al., 2009), the scope of observation on the influence of these risk factors was expanded to assess behavioral queues for substance use, STD acquisition, pregnancy and marital involvement. In addition, the reciprocal relationship between pregnancy status and marital status were also included in the framework. Lastly, histories of substance use and STDs were included as risk factors for Chlamydia, and the potential correlation between these factors were also considered based on the evidence from literature (Holmes et al., 1993; Miranda et al., 2000; Mertz et al., 2002).

Institutional Review Board Considerations

The protocol for the research was approved through an expedited review by the Research Review Panel, the Institutional Review Board at the Family Planning Council. A Letter of Reliance was signed with the Drexel University Institutional Review Board as partial requirement for the Community Based Master's Project.

Data Analysis

The collected data was analyzed using SAS version 9.1.3. The frequency of positive cases of Chlamydia was investigated as well as the distributions of risk factor variables. Ages of participants were calculated by subtracting date of birth from the screening date, and were grouped into the following intervals to ensure adequate number of subjects in each category: Under 20, 20 to 24, 25 to 29, 30 to 34, and 35 or older. In addition, a second age variable was created, which combined age into dichotomous categories for those below 30 years of age versus 30 years or older. To address the statistical challenges of analyzing a small sample and increase

the power of the study, dichotomous rearrangements were also made to the other variables. Race was combined into larger categories white and nonwhite; previous STDs and substance use were also combined to form dichotomous variables—history of STDs and history of drug use, respectively. Due to the inadequate number of Chlamydia cases in the study, history of Chlamydia ultimately replaced the urine-based Chlamydia test results as the outcome variable and therefore was not included as part of previous STDs.

The newly configured variables were first analyzed with one another using crosstabulation to examine the relationships conceptualized in the theoretical model in Figure 1.1. Next, each variable was analyzed univariately to assess the strength of association with history of Chlamydia. Stratified crosstabulation was performed adjusting for each variable; however, no meaningful interpretations could be drawn since the sample size in each category was substantially reduced from stratification, leading to an inadequate cell count for practical analysis. In order to address difficulties with stratification, multivariate analyses were performed where logistic regression models were computed to observe the adjusted associations among the variables as well as their effect on history of Chlamydia.

RESULTS

Demographic characteristics for newly incarcerated females are described in detail in Table 1.1. The ages of subjects ranged from 18 to 55 years with the overall mean age of 29.8 years. The obtained average age in the sample was approximately 10 years older than the high-risk age group for Chlamydia infection (Lofy et al., 2005), which may have contributed to the low positivity rate observed in this facility. Of 94 subjects who provided information on racial background, 50 subjects were Caucasians and 44 subjects were minorities. The age distributions of these two groups were nearly identical. The racial composition at George Hill confirmed

findings from other literature that there are disproportionally higher rates of minorities in prison than in the general population (De Ravello et al., 2005).

TABLE 1.1: DESCRIPTIVE STATISTICS OF GEORGE W. HILL CORRECTIONAL FACILITY

	*n	%		*n	%
Total N	194	100	**Marital Status**		
			Single	181	93.30
Age	187	100	Committed	1	0.52
Under 20	14	7.49	Married	6	3.09
20 – 24	48	25.67	Separated	4	2.06
25 – 29	41	21.93	Divorced	2	1.03
30 – 34	38	20.32			
35 or older	46	24.60	**Pregnancy**		
			Pregnant	5	2.58
Race	94	100			
White	44	46.81	**Test Results**		
Black	47	50.00	Chlamydia	2	**1.03
Asian	1	1.06	Gonorrhea	5	2.58
Other	2	2.13			
			History of		
Ethnicity (N=78)	78	100	Chlamydia	19	9.79
Hispanic	5	3.85	Other STDs	22	11.34
Non-Hispanic	73	96.15	Drug Use	65	33.51

Table above describes the distribution of various demographic and behavioral risk factors collected during screening at George W. Hill Correctional Facility.
*Total N for each variable is 194, unless specified otherwise.
**95% confidence interval: 0.18% – 4.07%

Of 78 inmates who provided information on ethnicity, five women were from Hispanic background. In addition, five women in the total sample reported that they were pregnant. Since the sample sizes of inmates who were Hispanic or pregnant were inadequate for conducting statistical analysis, the two variables were excluded from further investigation. In identifying marital status of the inmates, six women were currently married, two were divorced, four were

separated and one had indicated that she was in a committed relationship. These sample sizes were also insufficient for practical interpretation and, as a result, were not considered for further examination.

Among 65 inmates with history of substance use, the most frequently reported drugs were cocaine (42 users), marijuana (28 users), alcohol (25 users) and heroin (22 users). Although alcohol was one of the top three drugs reported, speculations were drawn regarding the observed rate based on the fact that alcohol is the most commonly used drug in the world and it is estimated that nearly 50 percent of Americans over the age of 12 are alcohol consumers (American Council for Drug Education [ACDE], 2009). The most commonly reported history of STDs were Chlamydia (19 cases) and Gonorrhea (12 cases), whereas the least frequently reported STDs were HPV (2 cases) and Herpes (1 case). A total of 22 inmates admitted to history of STDs other than Chlamydia, including one woman who was HIV positive.

In performing univariate analysis, the relationships among risk factors conceptualized in the theoretical framework were examined via crosstabulation for the variables with adequate sample sizes. As can be seen from Table 1.2, age appeared to be highly associated with other risk factors, as the subjects aged 30 years or older reported histories of STDs ($p=0.0335$) and drug use ($p=0.0003$) more frequently than those under 30 years of age. The age based differences were not surprising, as older inmates have had longer years of exposure to these risk factors and may have been exposed at a younger age. In examining the associations among other variables, a highly significant correlation was found between history of STDs and reporting past drug use ($p<0.0001$), indicating the presence of one risk factor as a behavioral marker for another. Although racial background did not appear to have an impact on history of STDs, a highly significant correlation was detected between white race and history of drug use (0.0007),

drawing further attention. However, the validity of this association was questionable, as less than half of the study population provided information on racial background.

TABLE 1.2: UNIVARIATE ANALYSES AMONG RISK FACTORS

Response Variable	Risk Factor	(%) Positive Response	p-value
History of STDs	Age ($\geq$ 30)	16.67	0.0335
	Age (< 30)	6.80	
History of Drug Use	Age ($\geq$ 30)	47.62	0.0003
	Age (< 30)	22.33	
History of STDs	Race (White)	25.00	0.5614
	Race (Nonwhite)	20.00	
History of Drug Use	Race (White)	86.36	0.0007
	Race (Nonwhite)	54.00	
History of STDs	Previous Drug Use (Yes)	27.69	<0.0001
	Previous Drug Use (No)	3.10	

Table above illustrates the relationships among Chlamydia risk factors by indicating the positive response rates (%) on the response variable in the presence or the absence of each risk factor, as well as the corresponding p-values.

In this study, only two cases of Chlamydia were discovered from urine-based testing for *Chlamydia trachomatis* culture, substantially limiting the analytic abilities of the study. To address the statistical challenges associated with a low number of cases, the methodology of the study was readjusted to set history of Chlamydia as the outcome of interest. Although selecting this route inevitably contributed to the ambiguity of temporal association among Chlamydia and the risk factors, it was concluded that the study would nonetheless provide valuable insights into the potential role of each risk factor as a behavioral marker for Chlamydia. Using this method, crosstabulations were performed to assess the relationships among history of Chlamydia and the risk factor variables. In computing the significance of association using a Chi-Square Test,

several variables had less than five expected counts in at least one of their cells, for which the Fisher's Exact Test was used. Table 1.3 describes the results from the crosstabulation of the risk factors with history of Chlamydia:

TABLE 1.3: UNIVARIATE ANALYSES OF RISK FACTORS VS. HISTORY OF CHLAMYDIA

Outcome Variable	Risk Factor	(%) Positive Response	p-value
History of Chlamydia	Age ($\geq$ 30)	14.29	0.0918
	Age (< 30)	6.80	
	Race (White)	15.91	0.3297
	Race (Non-White)	24.00	
	History of STDs (Yes)	18.18	0.1514
	History of STDs (No)	8.72	
	Previous Drug Use (Yes)	21.54	<0.0001
	Previous Drug Use (No)	3.88	

Table above describes the associations of the risk factors with history of Chlamydia by illustrating the positive response rates (%) in the presence or the absence of each risk factor as well as the corresponding p-values.

As can be seen from the table, history of drug use was found to be strongly associated with history of Chlamydia ($p<0.0001$), demonstrating the presence of substance use as a strong behavioral marker for Chlamydia infection. Although the correlation between age and history of Chlamydia was not found to be statistically significant ($p=0.0918$), the analysis suggested a slightly greater trend of reporting by the older group in comparison to the younger group. It appeared that more inmates with history of STDs tended to report history of Chlamydia than those with no past STD infections; however, the validity of this association was not supported with statistical significance ($p=0.1514$). Similarly, a weak positive association between racial minority and history of Chlamydia lacked statistical evidence ($p=0.3297$).

To assess the age-adjusted relationship between histories of drug use and STDs, the two variables were fitted in the logistic regression model with history of STDs as the outcome variable. Race was excluded from the first set of models since inclusion of the variable reduced the sample size by 50 percent due to missing data. Second set of logistic regression models were computed with race, but the results were not considered reliable due to the large set of missing data. As can be seen from Table 1.4, histories of drug use and STDs were significantly associated with one another ($p<0.0001$), suggesting an existence of behavioral queues triggering both risky behaviors. Furthermore, adjusting for age revealed a stronger magnitude of association between the two variables, further supporting the concept of a solid behavioral link between these risk factors.

TABLE 1.4: AGE-ADJUSTED EFFECTS OF PREVIOUS DRUG USE ON HISTORY OF STDS

Predictor Variable		**OR**	**95% CI**	**p-value**
Model 1				
History of Drug Use	(1 = Yes; 0 = No)	11.968	3.850 ~ 37.201	<0.0001
Model 2				
Age		1.037	0.984 ~ 1.093	0.1722
History of Drug Use	(1 = Yes; 0 = No)	13.581	3.725 ~ 49.509	<0.0001

Table above illustrates the odds ratios, 95% confidence intervals and p-values for the STD risk factors in each logistic regression model.

To assess the impact of each Chlamydia risk factor adjusted for other factors, the variables were considered for their fit in the logistic regression model. First, age was included in the models to remove confounding by the variable. Since history of drug use and history of STDs showed substantially high correlation with one another in univariate and multivariate analyses, the adjusted effect of each variable was computed together as well as separately to

assess differences in impact. As with previous analysis, when race was included in the logistic regression model, more than 50 percent of inmates had to be excluded from the analysis due to missing data. Based on the unreliability of data and susceptibility to biases, analyses were performed separately, with and without race, to ensure that the substantially reduced sample size caused by the inclusion of the variable would not eclipse the effect of the other variables. The odds ratios and confidence intervals from the final computations are illustrated in Table 1.5:

TABLE 1.5: AGE-ADJUSTED EFFECTS OF RISK FACTORS ON HISTORY OF CHLAMYDIA

Predictor Variable		**OR**	**95% CI**	**p-value**
Model 1				
Age		0.996	0.943 ~ 1.053	0.8920
History of Drug Use	(1 = Yes; 0 = No)	6.930	2.288 ~ 20.995	0.0006
Model 2				
Age		1.018	0.964 ~1.075	0.5206
History of STDs	(1 = Yes; 0 = No)	2.139	0.610 ~ 7.501	0.2349
Model 3				
Age		0.996	0.942 ~ 1.054	0.8995
History of Drug Use	(1 = Yes; 0 = No)	6.996	2.221 ~ 22.040	0.0009
History of STDs	(1 = Yes; 0 = No)	0.960	0.261 ~ 3.535	0.9510

Table above illustrates the odds ratios, 95% confidence intervals and p-values for Chlamydia risk factors in each logistic regression model.

From the results obtained, history of drug use was found to be strongly associated with Chlamydia after adjusting for age (p=0.0006). This finding concurred that history of drug use was indeed a valuable behavioral marker for Chlamydia infection in female inmates. Although history of STDs revealed a positive trend with Chlamydia after adjusting for age, there was not enough statistical evidence to confirm this association (p=0.2349). When histories of drug use and STDs were fitted into one model adjusting for age, the seemingly positive trend between

history of STDs and Chlamydia disappeared, suggesting that the effect of previous STDs on Chlamydia was being confounded by previous substance use. Furthermore, history of drug use maintained its association with Chlamydia after adjusting for age and history of STDs ($p=0.0009$). In fact, the adjustment slightly elevated the odds ratio, indicating a stronger magnitude of effect by history of drug use on Chlamydia. Lastly, race was included in the models; however, the results did not reveal any evidence of associations, largely due to the substantially reduced sample size resulting from exclusion of over 50 percent of the inmates, many of whom had history of Chlamydia.

DISCUSSION

This pilot study represents the first analysis of the newly collected Chlamydia screening data at George W. Hill Correctional Facility in Delaware County, Pennsylvania. The recently established prison-based screening program has permitted a new opportunity to discover characteristics relevant to this community as well as extrapolate findings to all female inmates across regions. As a first attempt at understanding the characteristics innate to female inmates at this facility, several demographic and behavioral risk factors related to Chlamydia in newly incarcerated females were investigated using univariate and multivariate techniques. Based on urine-based screening of newly incarcerated females from November 2009 to March 2010, two cases of Chlamydia were detected, which translated into a prevalence rate of 1.03 percent at this facility. The 95 percent confidence interval ranged from 0.18 percent to 4.07 percent, suggesting indifference in prevalence from the general female population. These results differed tremendously from previous research identifying the incarcerated female population as a high-risk group, which reported prevalence ranging from 7 to 27 percent across correctional settings around the country (Bernstein et al., 2006).

Several factors may have contributed to the low prevalence of Chlamydia at George Hill, including a shorter duration of data collection period in comparison to the other studies, insufficient sample size, and subject enrollment based on voluntary participation. Whereas past studies had reported findings from larger samples of data collected over multiple years of screening (Mertz et al., 2002; De Ravello et al., 2005; Lofy et al., 2005), this study based its findings on five months of screening period, restricting time and adequate sample size for proper and accurate measurement of characteristics in the study population. Insufficient data collection period thus may have increased the vulnerability of the study's findings to bias and variability, limiting the study's internal validity as well as generalizability.

The striking difference in Chlamydia positivity rate at George Hill could also be due to lack of participation by younger inmates exhibiting risky sexual behaviors, who are also more likely to be infected with Chlamydia. Studies have demonstrated that younger female inmates who admit to risky sexual behaviors are often characterized by their reluctance to utilize health care (Lofy et al., 2005). In addition, numerous studies have found a higher positivity rate of Chlamydia in younger inmates (Holmes et al., 1993; Mertz et al., 2002; De Ravello et al., 2005). In fact, De Ravello et al. (2005) indicated that the positivity rate observed in female prisoners between ages 13 and 24 years was twice as high as the rate observed in older inmates. This leads to a speculation that if a larger number of younger females had been screened, whether through mandatory or anonymous screening that further increased the participation rate, additional cases of Chlamydia could have been detected.

In performing univariate analysis with the risk factors, it was revealed that history of drug use and history of STDs were highly correlated. This result agrees with descriptions from the past research that individuals with history of drug users are also more likely to have history of

STDs (Holmes et al., 1993; Miranda et al., 2000; Mertz et al., 2002). Moreover, the study found a strong association between history of drug use and history of Chlamydia, suggesting a possible existence of one or more behavioral queues that could serve as potential triggers for both risky behaviors. The significant association detected between white race and history of drug use could be partially explained by several factors including socioeconomic disparities and social networks, but these characteristics cannot be examined in this study since no information has been collected on these factors. Furthermore, associations detected using race cannot be considered fully reliable in this analysis since more than half of inmates were missing data on race. Hence, the effect of race needs to be further investigated with a larger, more representative sample of the study population.

Multivariate analysis of the risk factors demonstrated that history of drug use was a valuable indicator for Chlamydia infection after adjusting for other risk factors. Moreover, the analysis revealed that (1) histories of drug use and STDs were strongly correlated, (2) the association between history of STDs and Chlamydia was confounded by previous drug use, and (3) the magnitude of association between history of drug use and Chlamydia was found to be stronger after adjusting for history of STDs. These findings further validate the notion that the behavioral queues inducing drug use are the same queues leading to risky sexual behaviors that elevate risk for Chlamydia infection as well as other STDs. The risk factors studied in this research deserve further, ongoing investigation and should be monitored continuously as additional screening data becomes available. A larger database developed over a longer data collection period will ensure a more representative sample of female inmates, increasing the power of the study and allowing for more accurate assessment of the risk factors.

Several limitations of this study restricted the methodology of research. First, there was inadequate time for data collection, which has led to a small sample of subjects consisting of only 194 participants. Not only did inadequate time and sample size contribute to a selection of the sample not fully representative of the population, it also affected the quality of findings by limiting the power of study during analyses. Second, insufficient number of Chlamydia cases also substantially limited the quality of findings, as history of Chlamydia was used as the outcome instead of the urine-based test results. In doing so, the temporal relationship between Chlamydia and the risk factors became ambiguous and could not be clarified. Furthermore, the influence of previous Chlamydia infection as a risk factor for re-infection could not be assessed.

Another limitation of this study is that while Chlamydia screening program was offered to all newly incarcerated females, the enrollment was strictly voluntary. It is possible that this form of subject recruitment may have induced selection bias and underestimated the true prevalence of previous Chlamydia infections as well as the true effects of the risk factors. For instance, those with history of drug use and STDs, who are also more likely to be infected with Chlamydia (Clarke et al., 2006), may have been reluctant to participate in the screening program in fear of the possible negative consequences of sharing unnecessary information. The prisoners' reluctance to share information can be demonstrated by the shockingly and unrealistically low rate of response on history of alcohol use. Of 194 subjects, only 25 inmates, or less than 13 percent of the study population, admitted to alcohol use. This observation leads to an implication that perhaps the quality of self-reported data provided by members of vulnerable populations such as this one may not be the most accurate and reliable source of information. Hence, this observation signifies the necessity for a checking mechanism that would ensure the accuracy of responses shared by members of this population, as well as other data collection

methods such as anonymous reporting that would reassure confidentiality of information and encourage honest responses from the inmates.

Another possibility for selection bias is that younger inmates exhibiting risky behaviors may not have enrolled in screening, as often characterized in literature by their unwillingness to access health care (Lofy et al., 2005). In addition, it is also possible that minority inmates who are often identified as high-risk groups for Chlamydia (De Ravello et al., 2005) may have been discouraged from screening due to the possible language, cultural, religious or other barriers, serving as yet another potential source of selection bias. In order to investigate racial and ethnic disparities in this facility regarding screening, data needs to be collected more consistently, as 100 women were missing data on race and 116 were missing information on ethnicity. Lastly, the inability to assess the effects of pregnancy and marital status on Chlamydia, as well as other behavioral risk factors that could have confounded the effects of the variables assessed in this study such as risky sexual behaviors, contraceptive use, history of sexual assault, and reasons for incarceration could have potentially limited the quality of findings.

CONCLUSION

In this pilot research of demographic and behavioral risk factors for Chlamydia at George W. Hill Correctional Facility, it was concluded that having a substance use background serves as a strong behavioral indicator for Chlamydia and other STD infections in female prisoners. The information obtained on drug use across correctional settings can therefore serve as a powerful tool for better targeting the population in need. Minor improvements to the study such as allowing for a longer data collection period, obtaining a larger and a more representative sample, and consistent data collection and entry will substantially enhance the quality of the findings from the study. In addition, major improvements such as making screening mandatory at the

facility, anonymous screening, improving the questionnaire to ensure accuracy of responses, and collecting additional behavioral variables could also vastly improve the study in terms of consistency, internal validity and generalizability. Lastly, the Chlamydia risk factors observed in this study deserve further investigation and should be explored thoroughly and continuously throughout future research.

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