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HIV Testing and Future Risk Behavior Among Legal-System-Impacted Young Adults

THESIS

submitted in partial satisfaction of the requirements
for the degree of

MASTER OF ARTS

In Social Ecology

by

Nicholas Stephen Riano

Thesis Committee:
Professor Elizabeth Cauffman, Chair
Associate Professor Kristine Molina
Distinguished Professor Julian F. Thayer

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ABSTRACT OF THE THESIS

HIV Testing and Future Risk Behavior Among Legal-System-Impacted Young Adults

by

Nicholas Stephen Riano

Master of Arts in Social Ecology

University of California, Irvine, 2022

Professor Elizabeth Cauffman, Chair

Background. HIV rates among young adults remain high, and those impacted by the justice system are at particular risk. Understanding the factors associated with HIV testing, as well as determining changes in risk behavior after an HIV test, may inform interventions to reduce HIV prevalence among this population.

Objective. To determine the individual, contextual, and demographic factors associated with HIV testing among legal-system-impacted young adults, and to explore whether a first HIV test is associated with future risky behavior when compared to never-tested individuals.

Design. This retrospective longitudinal study included those adjudicated by the criminal legal system between ages 14-17. Data were collected between 2000-2010; analyses were completed in 2021-2022.

Setting. Interviews occurred in participants' homes and community and correctional settings.

Participants. Participants were enrolled in Pathways to Desistance, a study that followed adolescents for seven years after an arrest for a serious offense. In total, 1,354 eligible and interested youth in Pennsylvania and Arizona were enrolled in Pathways, and a diverse subset of 981 male participants were included in this study.

Main Outcomes and Measures. Receipt of HIV testing served as the primary outcome; secondary outcomes included frequency of unprotected sex, number of unprotected sexual partners, and alcohol, marijuana, cigarette, and illicit drug use. Hypotheses were generated after data collection was completed.

Results. Significant predictors of HIV testing included the total number of sexual partners (OR=1.05, *p*=0.04), the absence of a biological father (OR=0.50, *p*=0.003), and living in Arizona vs. Pennsylvania (OR=0.272, *p*<0.001). Compared to those never tested for HIV, those newly tested significantly differed in the number of unprotected sexual partners (*b*=0.28, *p*<0.001), frequency of unprotected sex (*b*=0.36, *p*<0.001), and frequency of alcohol (*b*=0.28, *p*<0.001) and cigarette use (*b*=0.27, *p*<0.001) one year later.

Conclusions and Relevance. This study is one of the first to assess predictors of HIV testing among legal-system-impacted young adults living in community and carceral settings, and to assess changes in risk behavior before and after a first HIV test. Future studies should investigate changes in risk behavior among those newly tested to inform HIV testing and care improvement interventions for this population.

INTRODUCTION

In 2018, adolescents and young adults aged 13-29 represented 41% of all new HIV diagnoses in the United States (Centers for Disease Control and Prevention, 2020). Unfortunately, these young people were also the least likely to be retained in long-term HIV care or have a well-managed HIV viral load (Centers for Disease Control and Prevention, 2018b, 2018c). Several risk factors contribute to these disparities across individual, contextual, and demographic domains, including low rates of HIV testing, a greater number of sexual partners, widespread stigma and socioeconomic challenges, high rates of unprotected sexual intercourse and substance use, and higher prevalence of sexually transmitted diseases (Centers for Disease Control and Prevention, 2018b; Schnall et al., 2015).

Though the Centers for Disease Control and Prevention (CDC) and the US Preventive Services Task Force (USPSTF) recommend routine HIV testing for all young adults (Centers for Disease Control and Prevention, 2006; Moyer & U. S. Preventive Services Task Force, 2013), there remain profound differences in provider adherence to CDC and USPSTF recommendations (Burke et al., 2007). Providers have been especially unlikely to conduct routine HIV testing when treating young adults of color: as many as 63% reported never being offered an HIV test by a provider, regardless of relative risk (Peralta et al., 2007). As a result, rates of HIV prevalence across racial groups is woefully disparate: in 2018, HIV prevalence among White youth aged 13-24 was 16.3 per 100,000, prevalence among Latinx youth was 61.2 per 100,000, and prevalence among Black youth was 252.6 per 100,000 (Centers for Disease Control and Prevention & National Center for HIV/AIDS Viral Hepatitis STD and TB Prevention, 2021).

These disparities are particularly evident within the population of young adults impacted by the legal system (herein "system-impacted"), as young adults of color are overrepresented in justice settings, and HIV prevalence in justice populations is between 2 and 5 times higher than

the general US population (Office of Juvenile Justice and Delinquency Prevention, 2018; Westergaard et al., 2013). Additionally, prior research demonstrates severe compounded risk in this population: system-impacted young adults report sexual risk behaviors and substance use at rates far greater than the general population (Abram et al., 2017; Welty et al., 2016), are more likely to face HIV risk factors as a result of experiencing neighborhood disorganization, trauma, and exposure to violence (Butcher et al., 2015; Voisin, 2005; Voisin et al., 2011), and are less likely to be formally identified for testing and care by providers (Rhoades et al., 2014; Schnall et al., 2015; Tolou-Shams et al., 2019). While HIV testing in carceral facilities may attenuate certain HIV risks for this population (Haney-Caron et al., 2020), healthcare needs for system-impacted young adults released to community settings after incarceration are frequently overlooked (Belenko et al., 2009; Iroh et al., 2015). As community-based HIV testing has been related to lower sexual risk factors and increased condom use in the general population (Sulat et al., 2018), ensuring knowledge of and access to such services among system-impacted young adults is vital to reduce HIV risk factors, and in so doing, ultimately reduce the prevalence of HIV in this population.

Predictors of HIV Testing

As HIV testing is often touted as the entry to prevention and treatment, ensuring that system-impacted young adults are adequately tested and linked to care is critical for their long-term care (Kurth et al., 2015). Existing work provides the theoretical basis for the relationship between prior behaviors and subsequent risk in the general young adult population. For example, sensation seeking behavior and the use of substances prior to sexual activity may predict future HIV risk through contraception avoidance, though these factors were not used to determine the likelihood of HIV testing in this cohort (Hendershot et al., 2007). Among system-impacted teens (ages 12-18) living in the community, mental health and medical care engagement predicted future HIV testing, though psychosocial maturity (such as the ability to

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control impulses, delay gratification, resist peer influence, and consider the long-term implications of one's actions) did not (Haney-Caron et al., 2020).

Overall, little is known about the antecedent factors and behaviors associated with HIV testing within aggregate samples of community-based and incarcerated system-impacted young adults. As such, determining the individual, contextual, and demographic factors that are related to HIV testing may elucidate the disproportionate disease burden among this population.

Outcomes of HIV Testing

While a positive HIV diagnosis is related to reduced risk behavior among adults, a negative test result alone does not necessarily preempt a change in subsequent risk behavior (Weinhardt, 2005). Research among college-age adults found that healthcare providers addressing the topic of HIV when discussing health behavior changes and patient self-efficacy can increase rates of HIV testing and reduce high-risk sexual behavior (Rothman et al., 1999). As such, HIV testing coupled with adequate HIV counseling may be associated with an increase in HIV awareness, resulting in a decrease in future risky behavior among community-based system-impacted young adults. However, extant literature finds young adults living in the community without prior legal system impact may *increase* engagement in risky behavior after an HIV test, regardless of the result of the test, especially in the absence of HIV education or counseling (Sen, 2004). As such, it is potentially the coupling of HIV testing with appropriate counseling that may confer benefit among this population, above and beyond testing alone.

Few studies in the current literature examine HIV risk and testing rates among system-impacted young adults, and none to our knowledge have examined how HIV testing may affect future risk behavior and substance use within this population. While past longitudinal research has measured HIV risk in young adults post-incarceration (Abram et al., 2017), prior research has not examined the impact of HIV testing on future risk behaviors.

The aims of the current research are twofold: first, to determine the individual, contextual, and demographic differences between system-impacted young adults who do and

do not report HIV testing, and second, to assess whether receipt of a first HIV test is related to future risky sexual behavior and substance use in the year following the test.

METHODS

Participants

Participants were enrolled in Pathways to Desistance, a longitudinal study that followed 1,354 juvenile offenders for seven years after an arrest for a serious offense. Eligible youth were recruited from two sites: Philadelphia, Pennsylvania and Phoenix, Arizona, and were enrolled between November 2000 and January 2003. Participants were between 14-17 years old at the time of adjudication and had at least one arrest for a felony offense or an arrest for a misdemeanor weapons or sexual assault offense. The study capped felony drug offenses at 15% for the male sample to maintain offense heterogeneity. Sixty-seven percent of eligible youth agreed to participate in the study, and the total sample includes both males (N = 1,170) and females (N = 184). The participants were racially and ethnically diverse (44% Black, 29% Latinx, 25% White, and 2% Other Race); these percentages reflect the disproportionate number of youth of color impacted by the criminal legal system (Office of Juvenile Justice and Delinquency Prevention, 2018).

Procedure

The juvenile court systems in Philadelphia, PA and Maricopa County, AZ provided information on eligible youth to the study investigators, and all such youth were contacted to participate in the study (N = 2,009). Ultimately, 1,354 were enrolled, and 655 declined to participate. Before enrollment, all participants provided juvenile assent and their parents or guardians provided parental consent. Interviews with assented/consented youth were subsequently conducted in the participant's home, at a public location in the community, or within a facility if the participant was incarcerated.

The average length of time between adjudication and baseline interview was 39.6 days (SD = 20.6). These baseline interviews consisted of two 2-hour sessions and were conducted

over two days; follow-up interviews lasted two hours and were completed in one session. Data collection was computerized, and all questions were verbalized to prevent reading and comprehension issues. Privacy was assured via a certificate issued by the US Department of Justice, which protected all study data from any form of involuntary disclosure, including subpoenas and court orders (Schubert et al., 2004). This was done to encourage the accuracy and candor of participants' responses, especially for sensitive topics. After their baseline interviews, participants were interviewed every six months for three years, and then annually for the remaining four years of the study. Participants were compensated $50 for their participation in the baseline interview, and compensation increased over subsequent interviews, up to a maximum of $150 for completing the final interviews of the study. This resulted in an excellent timepoint retention rate among the full sample: 93% completed 6- and 12-month follow-up interviews, 91% completed the 1.5-, 2-, 2.5-, and 3-year follow-up interviews, 89% completed the 4- and 5-year follow-up interviews, 87% completed the 6-year follow-up interview, and 84% completed the 7-year follow-up interview. Recruitment and interviewing protocols were approved by the institutional review boards at all participating universities; see Schubert et al. for more information (Schubert et al., 2004).

Baseline Factors Associated with Future HIV Testing

To determine the individual, contextual, and demographic factors associated with HIV testing among this population, participants were first categorized based on their HIV testing history. This was accomplished through a 'Lifetime Receipt of HIV Testing' measure, which asked participants whether they had *ever* been tested for HIV during their lifetime. This measure was consistently administered to participants beginning at the four-year follow-up of the Pathways study, when participants were between the ages of 18-23. Due to a low response rate on this key measure, females (N = 184) were dropped.

The present study used the lifetime HIV testing measure at two timepoints – the four- and five-year follow-up interviews – to create two HIV testing variables. The first variable,

created for Aim 1, measured whether participants were ever tested for HIV in their lifetime prior to the five-year follow-up interview (i.e., participants who reported "yes" to the lifetime HIV test at the four- or five-year interview were coded 1; everyone else was coded 0). This binary Lifetime HIV Testing variable was created because the primary goal of Aim 1 was to understand the baseline predictors of *any* HIV testing.

Behavioral Outcomes After HIV Testing

The primary goal of Aim 2 was to understand whether a first HIV test was related to subsequent behavior change, and as such, a more nuanced measure of HIV testing was necessary. Using the HIV test variables measured at the four-year and five-year follow-up interviews, participants were placed into three categories: those who were previously tested for HIV (who reported being tested for HIV in their lifetime at the four-year follow-up interview; $N = 736$, "Previously Tested"), those who reported a first HIV test at the five-year follow-up interview (individuals who reported that they had not been tested for HIV in their lifetime at the four-year follow-up, but reported having been tested for HIV at the five-year follow-up interview; $N = 106$, "Newly Tested"), and those who reported that they had not been tested for HIV in their lifetime at both the four- and five-year follow-up interviews ($N = 139$, "Never Tested"). To strengthen analyses, participants who were missing a response to this question at either the four-year follow-up, the five-year follow-up, or both ($N = 182$) were excluded. Similarly, participants who answered "I don't know" when asked about whether they had been tested for HIV at the four-year follow-up, the five-year follow-up, or both ($N = 7$) were also excluded. A visualization of this categorization is presented in **Figure 1**.

To assess whether a new HIV test was related to subsequent high-risk sexual behavior and substance use, the present study compared the behavioral outcomes of those who were Newly Tested ($N = 106$) to those who were Never Tested ($N = 139$) for HIV in Aim 2. Outcome variables were measured at the six-year follow-up interview, which was approximately

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Figure 1. HIV Testing Categorization
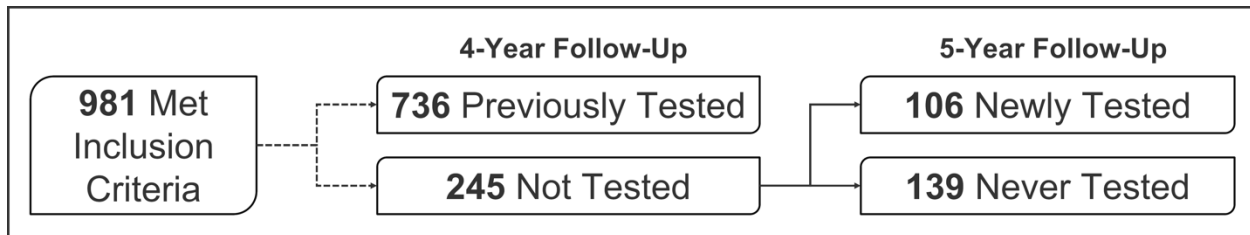
one year after the first HIV test for those in the Newly Tested group. The present study

also controlled for prior levels of the outcome variables at the four-year follow-up

interview, which was approximately one year prior to the first HIV test for those in the

Newly Tested group (and approximately two years before the outcome variable for the

Never Tested group).

Measures

Aim 1: Predictors of HIV Testing

While a plethora of factors could potentially influence whether a young person is tested

for HIV, the current project sought to accumulate and assess an evidence base of factors

associated with HIV testing identified in prior research. For the purposes of this study, intrinsic

attributes about a participant's lived experiences and mental health were considered "individual

factors," attributes associated with the nature of a participant's living environment and

upbringing were considered "contextual factors," and time-stable attributes were categorized as

"demographic factors." Each of these factors were measured at the baseline interview of the

Pathways study.

Key Grouping Variable: HIV Testing. Participants answered whether they had ever

been tested for HIV. As mentioned previously, this measure was collected at the four- and five-

year follow-up interviews, and was used to create the three key HIV testing groups (previously

tested for HIV at some point before the four-year follow-up: Previously Tested, tested for HIV for

the first time at the five-year follow-up: Newly Tested, and never tested for HIV by the five-year

follow-up: Never Tested). For Aim 1, the Newly Tested and Previously Tested groups were combined into a Lifetime Tested group to examine whether the baseline factors were related to ever having received an HIV test.

Individual Factors

      Mental Health Problem Index. As prior research has demonstrated that young adults with multiple mental health issues are at increased risk for HIV infection (Auslander et al., 2002), the current study sought to include a measure of mental health symptoms as a predictor to future HIV testing. At baseline and each follow-up interview, participants responded to the 53-item Brief Symptom Inventory (Derogatis & Melisaratos, 1983), which assessed the extent to which they had experienced mental health symptoms. Participants rated each item on a five-point Likert scale ranging from 0 ("Not at all bothered") to 4 ("Extremely bothered"). Questions were categorized into nine subscales spanning a wide variety of mental health disorders, and a Problem Index was calculated by summing participant Likert responses and dividing the sum by the total number of items endorsed. This resulted in a score that ranged from 0-4, with higher scores representing a greater overall severity of symptoms. Cronbach's alpha for the subscales that composed this calculated problem index ranged from 0.64-0.81.

      Number of Sexual Partners. A higher number of lifetime sexual partners has been well-established as a factor that confers additional risk for HIV among young adults (Kann et al., 2018). The present study assessed this factor at baseline via a single item, "How many people have you had sex with? By sex, I mean sexual intercourse." Importantly, this measure specifically assessed the number of consensual partners, and asked participants to omit instances of sexual assault.

      Total Exposure to Violence. Previous research has established a greater exposure to violence as an HIV risk factor, with more exposure conferring more risk (Richardson & Robillard, 2013; Voisin et al., 2011). At baseline, participants responded to an adapted version of the Exposure to Violence Inventory (Selner-O'Hagan et al., 1998), and reported whether they had

ever witnessed or experienced 13 different violent acts. Sample items included being attacked with a weapon, beaten up or mugged, witnessing someone getting shot, and witnessing a sexual assault. A total exposure to violence score was calculated by summing the number of violent acts witnessed with the number of violent acts experienced, with higher scores indicating greater exposure to violence.

Lifetime Illicit Drug Use. Substance use is a well-studied risk factor for HIV, especially among young adults impacted by the criminal legal system, such that a greater amount and variety of substance use confers additional risk (Tolou-Shams et al., 2007; Tolou-Shams et al., 2008; Tolou-Shams et al., 2019). As such, the current study sought to assess illicit drug use as a potential predictor of future HIV testing. At baseline, participants reported frequency and amount of illegal drug use (defined as the use of sedatives/tranquilizers, stimulants/amphetamines, cocaine, opiates, ecstasy, hallucinogens, inhalants, and/or amyl nitrate/odorizers; alcohol, tobacco, and marijuana use were excluded in the creation of this variable). As the construct of interest was whether a participant had ever engaged in illicit substance use at the time of the baseline interview, this measure was coded dichotomously. Participants who reported ever using at least one of the illicit substances listed above were categorized as having previously used illicit drugs, and those who did not report any illicit substance use were categorized as never having previously used such substances.

Lifetime Drug Consequences. As a correlate to lifetime drug use, the present study utilized a 17-item subscale from Chassin et al.'s Substance Use/Abuse Inventory assessing the social consequences of drug use among those who endorsed using substances (Chassin et al., 1991). Sample items included, "Have you ever had complaints from your family because of your drug use?," "Have you ever used drugs in situations where you might get hurt?," and "Have you ever felt such a strong urge or desire to use drugs that you could not stop yourself from doing it?" Endorsed items were summed to create a measure of lifetime drug consequences, with

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greater scores indicating more consequences of drug use. Those who did not report using drugs were coded 0.

   Lifetime Substance Use Treatment. As previously described, engagement with mental and physical healthcare services is associated with an increased likelihood for HIV testing among young adults (Haney-Caron et al., 2020). As such, the present study sought to determine whether participants had ever engaged in substance use treatment. Participants were administered a second subscale from the Substance Use/Abuse Inventory, and were asked if they had ever talked to a doctor, clergyman, or guidance counselor about their substance use; attended Alanon, Alateen, Alcoholics Anonymous, Narcotics Anonymous, or another self-help group; received treatment from a therapist for their substance use; or were admitted to a hospital because of substance use. Binary recoding assessed lifetime substance use treatment, such that each participant received a score of 0 if they had never endorsed any of the above treatments for substance use, or 1 if they endorsed substance use treatment one or more times.

Contextual Factors

   Biological Father Present in Household. Prior studies have established the importance of family stability and parental influence in the ability and decision for young people to get tested for HIV (Hadley et al., 2009; Randolph et al., 2017). The presence of a biological father in the home has been previously used as a proxy measure for family structure in developmental samples (Bocknek et al., 2014), and as such, the present study sought to determine whether a biological father was present in participants' households at baseline. Participants were asked about their family composition, and the presence of a biological father was coded dichotomously.

   Legal System Involvement. Involvement with the criminal legal system, especially in terms of arrests, has previously been identified as a factor that can increase risk for HIV among young adults (Tolou-Shams et al., 2007; Tolou-Shams et al., 2008). In the present study, offense history was probed via three unique measures: at the baseline interview, participants

self-reported the number of times they had ever been arrested, the age at their first arrest, and the variety of offenses they had committed. Offense variety included 22 categories of offenses adapted from the Self-Reported Offending scale (Huizinga et al., 1991); specific offense categories included property, drug, and violent offenses. The current study calculated offense variety as a proportion of the number of distinct types of offenses endorsed divided by the number of total offenses possible. Scores closer to 1 indicated a greater variety of committed offenses. Additionally, participants dichotomously reported whether they had ever been confined in a locked facility prior to being enrolled in the study.

Demographic Factors

General demographic information was collected at baseline, including age, study site location, race/ethnicity, and parents' highest level of education. Parental education was used as a proxy for socioeconomic status; this method has been previously validated in both adolescent and adult samples (Galobardes et al., 2007; Lien et al., 2001). This variable was reverse coded such that higher scores indicated lower education levels, thus indicating greater socioeconomic disadvantage.

Aim 2: Outcomes Associated with HIV Testing

The second aim of the study sought to determine whether a first HIV test was related to changes in risky sexual behavior and substance use among system-impacted young adults in the year following the test.

Substance Use Behavior

Substance Use Frequency. As substance use frequency has been previously associated with HIV risk behaviors in young adult samples (Patrick et al., 2012; Tolou-Shams et al., 2019), the present study sought to determine the association between a first HIV test and future substance use. At the four- and six-year follow-up interviews, participants self-reported their frequency of alcohol, marijuana, and cigarette use in the past year. A calculated dichotomous measure assessed whether participants had or had not used an illicit drug in the

past year (comprised of sedatives/tranquilizers, stimulants/amphetamines, cocaine, opiates, ecstasy, hallucinogens, inhalants, and/or amyl nitrate/odorizer use, as described above).

Risky Sexual Behavior

Risky sexual behavior was also assessed at the four- and six-year follow-up interviews, due to its strong association with HIV risk in similar samples (Teplin et al., 2003; Tolou-Shams et al., 2007). Participants reported the frequency of unprotected sex, as well as the number of unprotected sexual partners in the past year.

Statistical Analysis

Predictors of HIV Testing

First, a conditional binary logistic regression model identified the baseline factors associated with Lifetime HIV testing (i.e., any HIV testing prior to the five-year follow-up). As described previously, the binary Lifetime HIV Test outcome was coded such that anyone who reported receiving an HIV test prior to the five-year follow-up was coded 1, and everyone else with non-missing data was coded 0. As we were interested in *any* HIV testing among this population, the Newly Tested and Previously Tested groups were collapsed into a single category, which allowed an analysis that distinguished between Lifetime HIV Test and Never Tested individuals. All previously described individual, contextual, and demographic factors measured at baseline were simultaneously entered as covariates into the binary logistic regression predicting the two-category Lifetime HIV Test variable.

A supplemental multinomial logistic regression analysis was also conducted using the three-category HIV testing variable (Group 1: Previously tested for HIV at some point before the four-year follow-up, i.e., Previously Tested; Group 2: HIV tested for the first time at the five-year follow-up, i.e., Newly Tested; Group 3: Not tested for HIV at any point prior to the five-year follow-up, i.e., Never Tested) as the outcome.

HIV Testing as a Protective Factor against Future Risk Behavior

Poisson and logistic regression models determined whether the Newly Tested and Never Tested groups differed on the outcome variables at the six-year follow-up interview, controlling for all predictors in Aim 1, age at the four-year follow-up, and prior levels of the outcome variables (measured at the four-year follow-up). As mentioned previously, these outcomes represented behavior approximately one year after the first HIV test for the Newly Tested group (at the six-year follow-up), controlling for prior levels of the outcome variables, which were measured approximately one year prior to the first HIV test for the Newly Tested group (at the four-year follow-up).

Next, Generalized Estimating Equations examined the difference in the rate of change between the four-year and six-year follow-up interviews for the Newly Tested and Never Tested groups. These models included the same control variables as the prior models, including the predictors from Aim 1 and age at the four-year follow-up. All analyses were conducted with Stata I/C version 16 (StataCorp, 2017).

RESULTS

The final analytic sample contained 981 male participants. The analytic sample is racially/ethnically diverse (20.1% White, 39.2% Black, 36.3% Latinx, 4.4% Other Race/Biracial), and ranged from 14-19 years old at baseline (18-23 years old at the four-year follow-up). Descriptive statistics for each predictor variable are presented in **Table 1**, and correlations between all predictor variables are presented in **Table 2**.

Table 1. Sample Characteristics

	Mean	SD	Range	N, %
Individual Factors				
Mental Health Problem Index	1.73	0.67	1-4	904
Number of Sexual Partners	10.37	17.82	0-200	973
Total Exposure to Violence	5.46	2.98	0-13	979
Any Lifetime Illicit Drug Use				978
No				*534, 54.6%*
Yes				*444, 45.4%*
Lifetime Drug Consequences	3.20	3.90	0-16	979
Any Lifetime Substance Use Treatment				979
No				*783, 80.0%*

Yes				*196, 20.0%*
Contextual Factors				
Biological Father in Household				981
Absent				*736, 75.0%*
Present				*245, 25.0%*
Lifetime Number of Arrests	4.35	4.74	0-40	979
Age at First Arrest	13.79	1.98	5-18	962
Any Prior Incarceration				980
No				*492, 50.2%*
Yes				*488, 49.8%*
Lifetime Offending Variety	0.34	0.21	0-0.95	978
Demographic Factors				
Race/Ethnicity				981
White				*197, 20.1%*
Black				*385, 39.2%*
Latinx				*356, 36.3%*
Other				*43, 4.4%*
Socioeconomic Disadvantage	4.33	0.95	1-6	965
Age at Baseline	16.01	1.15	14-19	981
Study Site Location				981
Philadelphia				*478, 48.7%*
Phoenix				*503, 51.3%*

Table 2. Correlations between Aim 1 Predictors

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
1. Mental Health Problem Index	1.00														
2. Num. Sexual Partners	**0.17***	1.00													
3. Total Exposure to Violence	0.22***	**0.25***	1.00												
4. Any Lifetime Illicit Drug Use	**0.10***	0.04	**0.32***	1.00											
5. Lifetime Drug Consequences	**0.11***	**0.07**	**0.39***	**0.56***	1.00										
6. Any Lifetime Substance Use Treatment	0.03	0.02	**0.21***	**0.36***	**0.48***	1.00									
7. Biological Father Present	-0.03	-0.02	-0.06	0.04	0.03	0.01	1.00								
8. Lifetime Num. of Arrests	0.06	**0.11**	**0.31***	**0.28***	**0.31***	**0.26***	-0.02	1.00							
9. Age at First Arrest	-0.03	-0.03	**-0.18***	**-0.16***	**-0.20***	**-0.16***	**0.08**	**-0.52***	1.00						
10. Any Prior Incarceration	**0.11***	**0.13***	**0.23***	**0.28***	**0.31***	**0.27***	**-0.09**	**0.43***	**-0.39***	1.00					
11. Lifetime Offending Variety	**0.17***	**0.19***	**0.64***	**0.51***	**0.58***	**0.30***	0.02	**0.46***	**-0.28***	**0.35***	1.00				
12. Race/Ethnicity	**0.08**	0.00	**0.09***	**0.07**	0.03	-0.02	**-0.08**	**0.07**	-0.05	**0.09***	**0.10***	1.00			
13. Socioeconomic Disadvantage	0.04	-0.02	-0.04	-0.01	**-0.07**	-0.03	0.00	0.00	-0.02	**0.07**	-0.02	**0.30***	1.00		
14. Age at Baseline	0.03	**0.19***	**0.19***	**0.14***	**0.12***	**0.07**	0.00	**0.13***	**0.30***	**0.08***	**0.17***	0.06	-0.04	1.00	
15. Study Site	-0.05	**-0.24***	-0.06	**0.32***	**0.20***	**0.16***	**0.15***	**0.08**	-0.02	**0.08**	**0.18***	**0.18***	0.05	-0.04	1.00

Pairwise correlations of Aim 1 predictor variables. Bold typeface indicates significant correlations. **$p < 0.05$, ***$p < 0.0$

Aim 1

Aim 1 was used to identify the baseline predictors of Lifetime HIV testing. Results from

the logistic regression analysis (**Table 3**) revealed that the number of sexual partners, the

Table 3. Baseline Predictors of Any HIV Testing vs. No HIV Testing

	OR	*SE*	*p*	95% CI
Individual Factors				
Mental Health Problem Index	1.162	0.209	0.402	0.817, 1.653
Number of Sexual Partners	**1.046**	**0.024**	**0.045****	**1.001, 1.094**
Total Exposure to Violence	1.064	0.053	0.209	0.966, 1.172
Any Lifetime Illicit Drug Use	0.871	0.243	0.619	0.504, 1.503
Lifetime Drug Consequences	1.003	0.042	0.936	0.924, 1.090
Any Lifetime Substance Use Treatment	1.432	0.491	0.295	0.732, 2.802
Contextual Factors				
Biological Father Present	**0.498**	**0.116**	**0.003*****	**0.316, 0.787**
Lifetime Number of Arrests	1.096	0.062	0.105	0.981, 1.225
Age at First Arrest	0.894	0.080	0.210	0.750, 1.065
Any Prior Incarceration	0.807	0.219	0.428	0.475, 1.372
Lifetime Offending Variety	3.163	2.785	0.191	0.563, 17.764
Demographic Factors				
Race/Ethnicity				
White (ref)	*ref*	*ref*	*ref*	*ref*
Black	1.195	0.498	0.670	0.528, 2.705
Latinx	0.776	0.237	0.406	0.426, 1.413
Other	0.694	0.351	0.470	0.257, 1.872
Socioeconomic Disadvantage	1.008	0.121	0.946	0.796, 1.277
Age at Baseline	0.957	0.118	0.721	0.751, 1.220
Study Site Location (Phoenix)	**0.272**	**0.094**	**< 0.001*****	**0.138, 0.536**

Notes. Conditional binary logistic regression predicting any HIV test (i.e., Any Lifetime Testing Prior to Five-Year Interview) vs. no HIV test. All predictor variables included simultaneously. *VIF* was acceptable at 1.70. **p < 0.05, ***p < 0.01

absence of a biological father in the household, and study site location reported at baseline

were significantly associated with Lifetime HIV testing. Those who had been tested for HIV prior

to the five-year follow-up interview had a greater number of sexual partners at baseline

compared to those who had never been tested (odds ratio [OR], 1.05; 95% CI, 1.00-1.09, *p* =

0.045). Those reporting a biological father present in the household were less likely to have

been tested for HIV (OR, 0.50; 95% CI, 0.32-0.79, *p* = 0.003), and those living in Phoenix were

also less likely to have been tested for HIV (OR, 0.27; 95% CI, 0.14-0.54, *p* <0.001). The mean

variance inflation factor (VIF) for included covariates was acceptable at 1.70. Note that the

results from the multinomial logistic regression analysis predicting the three category HIV testing variable (Previously Tested; Newly Tested; Never Tested) revealed similar findings (**Table 4**).

Table 4. Baseline Predictors of HIV Testing Groups

	Main Effect		Newly Vs. Previously Tested		Never Vs. Previously Tested		Newly Vs. Never Tested	
	X^2	p	B	p	B	p	B	p
Individual Factors								
Mental Health Problem Index	2.07	0.355						
Number of Sexual Partners	4.28	0.118						
Total Exposure to Violence	1.67	0.433						
Any Lifetime Illicit Drug Use	0.47	0.790						
Lifetime Drug Consequences	2.55	0.279						
Any Lifetime Substance Use Treatment	1.19	0.553						
Contextual Factors								
Biological Father Present	**8.90**	**0.012****	-0.052	0.852	**0.684**	**0.004*****	**-0.736**	**0.023****
Lifetime Number of Arrests	2.90	0.235						
Age at First Arrest	1.77	0.413						
Any Prior Incarceration	2.17	0.338						
Lifetime Offending Variety	2.68	0.262						
Demographic Factors								
Race/Ethnicity	5.20	0.518						
Socioeconomic Disadvantage	2.25	0.326						
Age at Baseline	0.39	0.822						
Study Site Location (Phoenix)	**20.79**	**< 0.001*****	**0.813**	**0.012****	**1.448**	**< 0.001*****	-0.635	0.148

Notes. Results in table derived from multinomial logistic regression predicting the three category HIV testing group (Group 1: tested for HIV at some point before the four-year follow-up [Previously Tested]; Group 2: tested for the first time at the five-year follow-up [Newly Tested]; Group 3: not tested for HIV any time before the five-year follow-up interview [Never Tested]). All covariates entered simultaneously. **p < 0.05, ***p < 0.01

Aim 2

Aim 2 was used to identify whether young adults' first HIV test was related to change in subsequent substance use and risky sexual behavior. Results from the Poisson/logistic regression analysis demonstrated that the Newly Tested group engaged in more frequent alcohol use (b = 0.28, p <0.001), cigarette use (b = 0.27, p <0.001), and unprotected sex (b = 0.36, p <0.001), and had a greater number of unprotected sexual partners (b = 0.57, p = 0.001) than the Never Tested group at the six-year follow-up. Importantly, these results were significant even after controlling for prior levels of the outcome variables, all predictors from Aim 1, and age at the four-year follow-up (**Table 5**). Note that there were no group differences on marijuana

frequency or other illicit drug use at the six-year follow-up. **Table 5** includes also includes the

associations between the covariates and the outcome variables.

Table 5. Behavioral Outcomes One Year after HIV Testing (i.e., Newly Tested vs Never Tested), Controlling for Prior Levels of Outcome and All Aim 1 Predictors

Predictors	Outcome Variables					
	Substance Use Behavior				Risky Sexual Behavior	
	Alcohol Use Frequency (N=198)	Marijuana Use Frequency (N=198)	Cigarette Use Frequency (N=197)	Any Illicit Drug Use (N=209)	Number of Unprotected Sexual Partners (N=178)	Freq. Unprotected Sex (N=192)
	(B, *p*)	(B, *p*)	(B, *p*)	(B, *p*)	(B, *p*)	(B, *p*)
Newly Tested vs. Never Tested	**0.279, < 0.001***	-0.003, 0.978	**0.267, < 0.001***	1.276, 0.558	**0.571, < 0.001***	**0.361, < 0.001***
Prior Level of Outcome Variable	**0.017, < 0.001***	**0.160, < 0.001***	**0.014, < 0.001***	**8.468, < 0.001***	**0.143, < 0.001***	**0.005, < 0.001***
Individual Factors						
Mental Health Problem Index	**0.056, 0.043***	0.074, 0.343	**0.257, < 0.001***	0.620, 0.200	**0.290, 0.010***	**0.158, < 0.001***
Number of Sexual Partners	-0.003, 0.306	-0.003, 0.509	**-0.009, 0.000***	0.974, 0.360	0.002, 0.821	0.000, 0.984
Total Exposure to Violence	**0.091, < 0.001***	0.010, 0.606	**-0.029, < 0.001***	1.181, 0.083	-0.045, 0.190	**-0.027, < 0.001***
Any Lifetime Illicit Drug Use[1]	0.071, 0.074	0.212, 0.064	0.042, 0.232	N/A[1]	**0.450, 0.008***	**0.692, < 0.001***
Lifetime Drug Consequences	-0.010, 0.108	-0.004, 0.785	**0.033, < 0.001***	0.913, 0.223	**-0.100, 0.001***	**-0.048, < 0.001***
Any Lifetime Substance Use Treatment	**0.411, < 0.001***	-0.038, 0.781	0.058, 0.131	1.699, 0.424	0.411, 0.072	**-0.086, 0.010***
Contextual Factors						
Biological Father Present	0.038, 0.291	0.025, 0.791	**0.347, < 0.001***	1.071, 0.875	-0.042, 0.792	0.030, 0.144
Lifetime Number of Arrests	**-0.032, < 0.001***	-0.045, 0.079	**0.055, < 0.001***	0.828, 0.095	-0.008, 0.800	**-0.036, < 0.001***
Age at First Arrest	-0.015, 0.227	-0.024, 0.466	**0.103, < 0.001***	**0.697, 0.028***	0.010, 0.862	**-0.070, < 0.001***
Any Prior Incarceration	**-0.547, < 0.001***	0.079, 0.496	**-0.639, < 0.001***	0.898, 0.824	**-0.638, 0.001***	**0.126, < 0.001***
Lifetime Offending Variety	-0.079, 0.555	0.307, 0.416	**1.351, < 0.001***	**53.193, 0.018***	**1.293, 0.035***	**-0.456, < 0.001***
Demographic Factors						
Race/Ethnicity						
White (ref)	*ref*	*ref*	*ref*	*ref*	*ref*	*ref*
Black	**-0.357, < 0.001***	-0.211, 0.221	**-0.855, < 0.001***	**0.145, 0.017***	**-0.733, 0.040***	**-0.310, < 0.001***
Latinx	**-0.152, < 0.001***	-0.065, 0.566	**-0.384, < 0.001***	0.357, 0.066	-0.147, 0.390	**0.159, < 0.001***
Other	**-0.743, < 0.001***	-0.427, 0.078	**0.357, < 0.001***	0.087, 0.061	-0.717, 0.071	**0.412, < 0.001***

Socioeconomic Disadvantage	**0.005, 0.002***	0.002, 0.594	**-0.003, 0.018**	1.121, 0.619	**-0.017, < 0.001***	**0.012, < 0.001***
Age at four-year follow-up	**-0.068, < 0.001***	**0.099, 0.039**	**-0.060, < 0.001***	1.469, 0.084	**0.210, 0.009***	**-0.033, 0.002***
Study Site Location (Phoenix)	**0.860, < 0.001***	**-0.313, 0.024**	**-0.367, < 0.001***	**0.186, 0.009***	0.382, 0.190	**-0.227, < 0.001***

Notes. Estimates in table derived from Poisson or logistic regressions (depending on the distribution of the outcome variable) predicting the behavioral outcome variables that were measured at the six-year follow-up. The primary aim in these analyses was to determine whether the Newly Tested group differed in behavioral outcomes one year after their first HIV test when compared to the Never Tested group. All models controlled for the prior level of the outcome variables. For those in the Newly Tested group, prior levels of the outcome variables were measured in the one year prior to the first HIV test. Models also adjusted for all Aim 1 predictors. [1]The only exception to the inclusion of Aim 1 predictors was that lifetime illicit drug use was not included as a covariate, as prior illicit drug use at the four-year follow-up interview was used instead to be consistent with the other outcomes. Models also adjusted for age at the four-year follow-up interview. **$p < 0.05$, ***$p < 0.01$

Next, population-averaged generalized estimating equations were used to further evaluate the rate of change for each outcome between the four-year and six-year follow-up, and to determine whether the rate of change differed between the Newly Tested and Never Tested groups. As shown in **Table 6**, the rate of change differed significantly between the two groups on alcohol use frequency, cigarette use frequency, frequency of unprotected sex, and number of unprotected sexual partners (**Table 6, Figure 2**).

For alcohol use frequency, both groups increased between the two timepoints, but the Newly Tested group demonstrated a steeper increase (Newly Tested $b_{TIME} = 0.46$, $p < 0.001$;

**Table 6. Differences in Rate of Change on Outcome Variables Between Newly Tested and Never Tested HIV Groups**

Outcome Variable	Time x Testing Category (i.e., Newly Tested v. Never Tested)		
	B	**p**	**95% CI**
Substance Use Behavior			
Alcohol Use Frequency	**0.387**	**< 0.001***	**0.308-0.466**
Marijuana Use Frequency	-0.020	0.816	-0.192-0.151
Cigarette Use Frequency	**0.098**	**< 0.001***	**0.048-0.149**
Any Illicit Drug Use	0.658	0.262	-0.492-1.809
Risky Sexual Behavior			
Number of Unprotected Sexual Partners	**0.434**	**< 0.001***	**0.387-0.481**
Frequency of Unprotected Sex	**0.386**	**0.039**	**0.019-0.753**

Notes. Population-averaged Generalized Estimating Equation (GEE) models predicting the outcome variables (e.g., substance use and risky sexual behavior), controlling for all predictor variables from Aim 1 and age at the four-year follow-up. Estimates in **Table 6** represent the interactions between time and the testing variable (Newly Tested vs. Never Tested), which demonstrate whether the rate of change between the four-year follow-up (i.e., prior to HIV test for the Newly Tested group) and the six-year follow-up (i.e., one year after HIV test for the Newly Tested group) differs for the two groups. **$p < 0.05$, ***$p < 0.01$

Never Tested b_{TIME} = 0.07, p = 0.005). For cigarette use frequency, the Newly Tested group

demonstrated no significant change between the two timepoints, although the Never Tested

group significantly decreased between the four- and six-year follow-up interviews (Newly Tested

b_{TIME} = -0.01, p = 0.695; Never Tested b_{TIME} = -0.11, p < 0.001). For frequency of unprotected

sex, both groups increased between the two timepoints, but the Newly Tested group

demonstrated a steeper increase (Newly Tested b_{TIME} = 0.70, p < 0.001; Never Tested b_{TIME} =

0.27, p < 0.001). For number of unprotected sexual partners, the Newly Tested group

demonstrated a significant increase between the four-year and six-year interviews, although the

Never Tested group did not demonstrate a significant change during this period (Newly Tested

b_{TIME} = 0.61, p < 0.001; Never Tested b_{TIME} = 0.22, p = 0.088). **Figure 2** visualizes these

models.

Figure 2. Within-Group Change on Outcome Variables
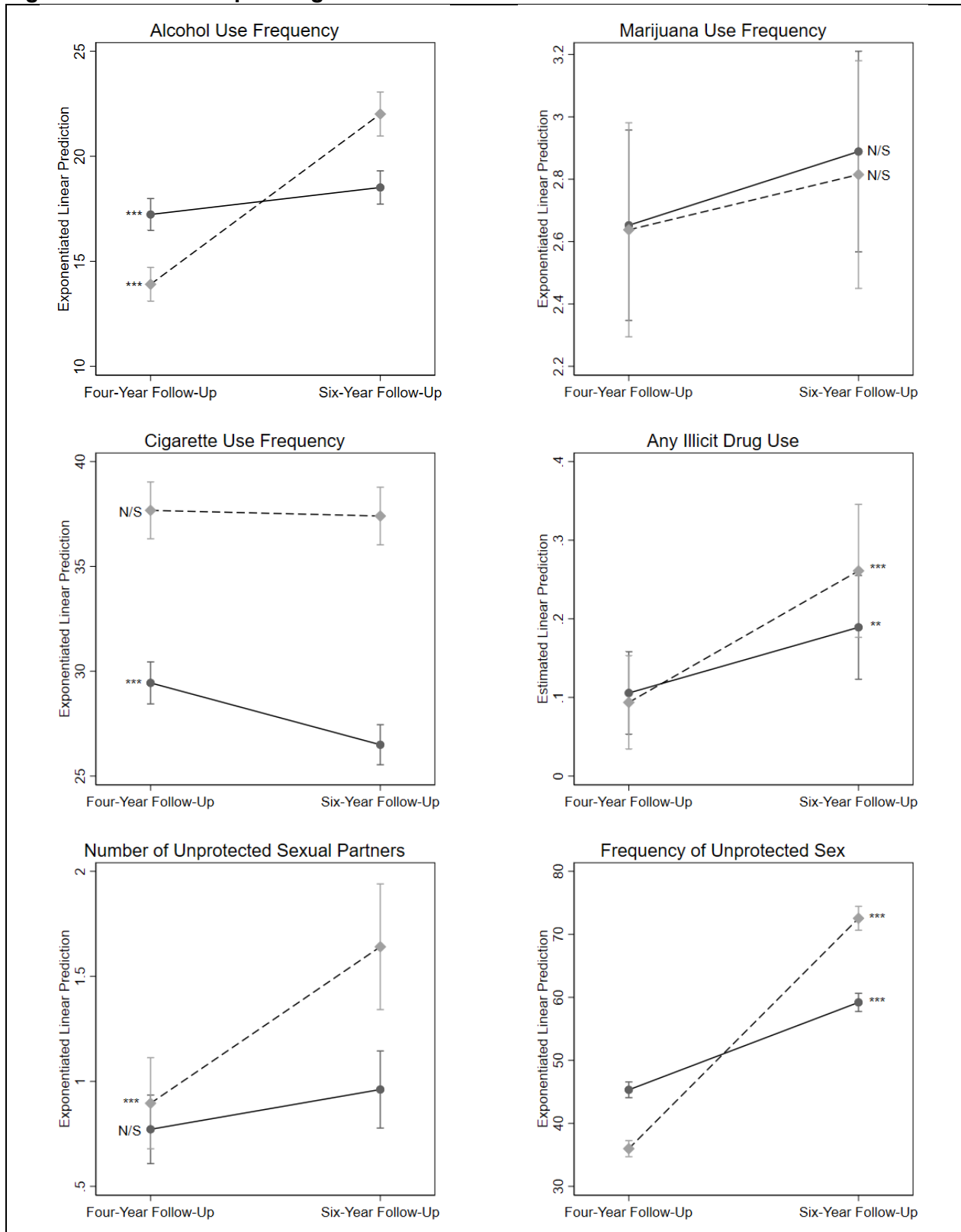
Notes. Dashed line represents Newly Tested group, solid line represents Never Tested group.
Significance of within-group slopes represented by asterisks and N/S; *p* > 0.05, N/S (not significant),

p < 0.05, ***p < 0.01. For the Newly Tested group, the four-year follow-up value represents the outcome variable one year prior to the first HIV test and the six-year follow-up value represents the outcome variable approximately one year after the first HIV test. Results from statistical tests comparing the slopes are depicted in **Table 6.

DISCUSSION

Baseline Factors Predicting HIV Testing

This study is one of the first to assess the predictors of HIV testing among young adults impacted by the criminal legal system, without limiting the sample to only those living in the community or those living in secure custody. Additionally, this study is the first to assess whether HIV testing results in changes in risk behavior one year after the test among those impacted by the legal system.

Significant predictors of HIV testing included the number of sexual partners, the presence of a biological father in the household, and study site location reported at baseline. All results generally follow findings from previous research: for example, it is well established that a greater number of sexual partners confers greater HIV risk among this cohort (Kann et al., 2018), and it is encouraging that this population is more likely to be tested as participants' number of sexual partners increases, suggesting that healthcare providers may be conscious of this risk and order HIV testing as a result.

It is theoretically plausible that the presence of a biological father in the household would confer a decreased testing likelihood, as prior research has established this variable as a proxy for overall family structure (Bocknek et al., 2014). As a result, a more stable family may decrease provider necessity to refer a young adult for testing simply due to decreased overall risk for HIV infection. Additionally, as parents have been established as some of their children's first and most influential HIV/AIDS educators (Krauss & Miller, 2012), it follows that the presence of parents may ultimately reduce overall risk for HIV.

Alternatively, it is possible that young male adults who attempt to communicate about sexual risk with their fathers may encounter resistance to HIV testing, as prior studies have

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demonstrated that masculine norms surrounding HIV and sexual health encourage unprotected sex, reject HIV testing, and discourage seeking help for sexual health issues (Jacques-Aviñó et al., 2019; Marcell et al., 2007). While the Pathways to Desistance study did not explicitly measure sexual risk communication between parents and their children, the presence of a biological father may ultimately reflect parental presence, engagement, and heightened risk monitoring, or indicate problematic communication of sexual risk between fathers and sons. However, definitively determining this relationship is beyond the scope of this study, and further research is needed to explore the nuance and interplay between paternal presence/absence and HIV testing.

Study site location also predicted future HIV testing, such that those living in Phoenix, Arizona at baseline were less likely to be tested by the five-year follow-up than those living in Philadelphia. This may be due to an overall difference in HIV prevalence between Phoenix and Philadelphia at the time of study enrollment. In 2008, around the four- and five-year follow-up period, the HIV prevalence of males between the ages of 13-24 in Maricopa County, AZ was 69.6 per 100,000, whereas the prevalence in Philadelphia County, PA was 405.4 per 100,000 (Centers for Disease Control and Prevention & National Center for HIV/AIDS Viral Hepatitis STD and TB Prevention, 2021). As a result, disparities in HIV testing by study site location can likely be geographically explained, such that HIV salience among providers and residents may be higher in places that experience a higher burden of the disease.

It is notable that the presence of several indirect HIV risk factors associated with testing in prior studies (e.g., exposure to violence, mental health symptoms) were not shown to be significantly associated with HIV testing. This may be due to the fact that the present analysis entered all predictors simultaneously – when measured bivariately, these risk factors were significantly associated with testing (data available upon request), but this significance appeared to be accounted for by some of the other more robust predictors.

Behavior Change between those Newly and Never Tested for HIV

When compared to those who had never been tested for HIV by the five-year follow-up, those newly tested were more likely to increase the frequency of their alcohol and cigarette use, as well as the frequency of unprotected sex and the number of unprotected sexual partners in the year after their first HIV test, even after adjusting for HIV testing predictors identified in Aim 1 and prior levels of each outcome variable. In other words, a participant newly tested for HIV increased frequency of alcohol use, cigarette use, and unprotected sexual intercourse, as well as in the number of unprotected sexual partners, between the year prior and year after their test, when compared to those who had never been tested for HIV. Though prior research in this area is limited, these findings align with prior research that demonstrated an increase in risk behavior among young adults after an HIV test, regardless of the result of the test, especially in instances where HIV counseling and education were absent (Sen, 2004).

It is possible that this increase in risk behavior after an HIV test is due to a lack of appropriate HIV counseling. Historically, HIV risk-reduction counseling was provided to all patients receiving an HIV test, but this strategy has fallen out of favor due to staffing needs and cost (Farnham et al., 2008). In addition, the advent of the HIV rapid test can provide results in minutes, and patients might not be willing to remain at the testing site or clinic to receive such counseling, even if available. As such, the opportunity for counseling may be limited. Additionally, the lack of counseling may confer a sense of imperviousness among young adults who receive a negative result, increasing the potential for future risk behavior, a finding which had been demonstrated previously in an adult sample of men who have sex with men (Hoenigl et al., 2015). Regardless, prior studies have demonstrated the effectiveness of risk-reduction counseling in reducing future HIV risk behavior and STI infection (Kamb et al., 1998), and the CDC currently provides sixty evidence-based interventions that have demonstrated effectiveness in reducing future HIV risk (Centers for Disease Control and Prevention, 2022).

While some of these efforts have been demonstrated to be effective in the system-impacted young adult population (Bryan et al., 2009; Donenberg et al., 2015), the majority are differentially available, only offered at specific testing sites, or are not tailored specifically for young adults (Donenberg et al., 2015; Metsch et al., 2013). To better reduce future HIV risk within this uniquely vulnerable system-impacted young adult population, carceral facilities, post-release programming, and community clinics serving this population should prioritize making these evidence-based interventions part of the HIV testing process for all patients.

Limitations

This study was limited by several factors. First, all HIV testing information was self-reported by study participants, and independent verification via medical record information was not possible. However, the exclusion of participants who had missing responses or stated that they didn't know whether they had been tested likely renders the need to independently verify receipt of testing moot.

Second, while we know who among the participants were tested for HIV and generally when, we do not know the results of these tests, the impetus behind testing administration, nor where the testing took place (in a carceral facility, in the community, at a clinic, etc.). Additionally, as we do not know specificially when those in the Previoulsy Tested group were tested, predictors measured at baseline may have been successive to testing. As such, no conclusions can be made about whether the result of the test influenced any changes in risk behavior, nor whether facility-administered testing was available. Even still, this knowledge likely would not change the outcomes of the study, as it has been shown that HIV testing can increase future risk behavior regardless of the result (Sen, 2004).

Finally, this study only included male young adults, and purposively omitted females due to an extremely low response rate on key HIV testing measures. While it is of utmost importance to understand predictors and outcomes of HIV testing for all young adults, both HIV incidence as well as legal system impact is heavily skewed toward males – 81% of all new HIV diagnoses

in 2018 were among males (Centers for Disease Control and Prevention, 2018a), and about 75% of young adults aged 18-24 arrested in 2018 identified as male (Office of Juvenile Justice and Delinquency Prevention, 2018). Nonetheless, future research should examine the research aims studied here with samples of legal system-impacted young women.

CONCLUSION

Young adults impacted by the criminal legal system represent a uniquely vulnerable subpopulation at increased risk for HIV infection, and it is troubling to note the increase in several risk outcomes after a first HIV test when compared to those who are not tested, above and beyond prior engagement in risky behaviors. Future research should examine the behavioral reasons behind these increases, paying special attention to perceived self-assessment of risk before and after an HIV test, especially when such testing does not include a health education or counseling component. Further, as system-impacted young adults represent a health disparities population by nature of their legal and carceral involvement (Bui et al., 2019), providers and policymakers should increase preventive screening in this population, especially for high-risk infectious diseases like HIV.

Overall, novel interventions specifically tailored to those that endorse the antecedent factors that negatively predict future HIV testing have the potential to improve HIV testing and care among system-impacted young adults, especially when combined with developmentally-sensitive approaches to HIV counseling and education. Such efforts may ultimately serve to reduce the increased burden of HIV demonstrated not only within this unique subpopulation of at-risk young adults, but also among young adults at large.

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