AIDS and Behavior
https://doi.org/10.1007/s10461-024-04575-w

ORIGINAL PAPER

A Nationally Representative Analysis of Substance Use and Sexual Health Correlates Associated with HIV and STI Testing among Adolescents

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Accepted: 3 December 2024

Abstract
Adolescents in the United States (US) continue to be disproportionately impacted by HIV and STIs. We investigated the associations between sexual health and substance use behaviors with HIV and STI testing among high school students in the US. Cross-sectional weighted stepwise multivariate logistic regression models were conducted to determine the odds of lifetime HIV and STI testing among students, stratified by sex. Drugs and alcohol before sex, condom use during sex, number of sex partners, sex of sexual partners, substance use (e-cigarette, alcohol, and cannabis) frequency, lifetime cocaine use, and lifetime prescription drug misuse were predictors, adjusting for race/ethnicity and age. This analysis used the 2019 and 2021 cycles of the CDC Youth Risk Behavioral Surveillance System (YRBSS) data. Our sample of adolescents ($n=30,909$) had a mean age of 16; 51% were male. Females engaging in substance use had increased odds of HIV and STI testing whereas that pattern did not reflect among males. Multiracial male adolescents had increased odds of HIV testing. Females engaging in condomless sex had lower odds of HIV and STI testing. This study highlights the need for tailored HIV and STI testing promotion and ongoing efforts for dismantling barriers to testing services. Furthermore, our study suggests that screenings follow the concurrent nature of sexual health and substance use behaviors of adolescents for integrated HIV/STI testing.

Keywords HIV Testing · STI Testing · Substance use · Adolescent Health · Sexual Health

Introduction

Receiving knowledge and access to testing for human immunodeficiency virus (HIV) and other sexually transmitted infections (STIs) is critical for adolescents to feel empowered in maintaining their sexual and reproductive health and foundational for entering the HIV care continuum [1]. Studies suggest that adolescents carry a significant burden of HIV or STI infections, often unknowing of their status [2–6]. In 2022, 60% of new HIV diagnoses were among adolescents and young adults ages 13 to 24 years old [7], and adolescents accounted for half of the 2.5 million new STI diagnoses in 2021 [8], with rates continuing to increase [9]. Sex, gender, and race inequities exist for HIV and STI testing and diagnoses, especially for females and Black adolescents [3, 6, 8, 10, 11]. The inequities to individual HIV and STI testing can be structurally driven, where adolescents who are positioned at different social locations (e.g., age, race, gender) experience unique manifestations of oppression (e.g., ageism, racism, sexism) that compound into barriers, like healthcare-related discrimination, lack of comprehensive sexual health education, lack of confidential services, and social stigma around HIV and STIs that affect access to and maintenance of HIV and STI preventative services [12–16].

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Published online: 11 December 2024

Despite long-standing guidelines from the Centers for Disease Control and Prevention (CDC), HIV and STI testing rates among adolescents are low [2, 3]. Current HIV testing guidelines from the CDC recommend adolescents and adults of both sexes ages 13 to 64 test for HIV at least once, and those who engage in certain sexual behaviors that may not be health promoting (e.g., condomless sex, multiple sex partners) or share injection drug equipment to test for HIV at least once a year [17]. Current STI testing guidelines from the CDC recommend annual chlamydia and gonorrhea testing for all sexually active women younger than 25 years and women 25 years and older who have new or multiple sex partners, or a sex partner with an STI diagnosis [17]. Between 2005 and 2019, multiple studies have shown that adolescent and young adult HIV testing rates range from 20 to 30% and that STI testing rates range from 22 to 53% [4, 6, 18, 19]. These ranges are concerning, as evidence has shown that early detection and treatment of HIV and STIs can improve quality of care and life [19].

There are several factors that can influence HIV and STI testing, including unhealthy sexual and substance use behaviors. Sexual behaviors have been associated with HIV and STI infections through the nature of sexual activity along with the nuanced transmission dynamics within networks of sexual partners [20, 21]. Sexual health behaviors associated with HIV and STI infections often involve engaging in condomless sex or having multiple partners [6, 8, 22]. A study using data from the 2011 Youth Risk Behavior Surveillance System (YRBSS) found that 40% of sexually active adolescents reported no condom use during their last sexual intercourse [21, 23]. This can be attributed to adolescence being a period where cognitive and emotional processing is growing and adapting. These changes may lead to unplanned behaviors, especially with regards to sexual activity, that can place adolescents at risk of negative sexual and reproductive health outcomes, like HIV, STIs, and unplanned pregnancy [3, 6, 21]. For example, studies have found around 20% of sexually active adolescents report consuming alcohol or drugs before their last sexual activity [21, 24, 25]. Adolescents are in a stage where they are experimenting with their sexuality and substance use, sometimes combining the two together, which may lead to cognitive impairment and thereby increase the risk of unsafe sexual practices [26]. In addition to alcohol, studies have shown a connection between frequent cannabis and e-cigarette use and more frequent condomless sex [27, 28] and a higher number of sexual partners [27, 29]. There are additional substance use patterns among adolescents that warrant investigation into their associations with HIV and STI testing, such as prescription pain medication misuse and other illicit drug use known to be prevalent among minority youth [30–33].

Evidence shows unhealthy sexual behaviors and substance use among adolescents increases their risk of acquiring HIV and STIs [34, 35]. Studies have also found that students reporting unhealthy sexual behaviors and substance use are positively associated with HIV testing [3, 19]. Previous research has explored correlates of HIV testing using nationally representative data from 2013 to 2015 [3]. There have been new trends in substance use (i.e., e-cigarette use has significantly risen in prevalence in the years since), and there is a gap in research focusing on STI testing and on sex/gender differences for adolescents at the national level. Therefore, to fill these gaps, the purpose of this analysis was to investigate the associations between unhealthy sexual behaviors and substance use with HIV and STI testing among adolescents in the U.S. using recent data and uncover any sex differences.

Methods

Participants

National data from the 2019 and 2021 Youth Risk Behavior Surveillance System (YRBSS) cycles were used for this analysis [36]. The YRBSS is a system of biennial cross-sectional surveys administered to high school students which captures data on six categories of health-related behaviors (e.g., behaviors that contribute to unintentional injuries and violence, sexual behaviors related to unintended pregnancy and sexually transmitted diseases [including HIV], substance use, unhealthy dietary behaviors, and physical activity) that contribute to the leading causes of death and disability among adolescents. The survey employs a sampling design that ensures national representation of demographic groups. Data used for this secondary analysis are de-identified and publicly available, thus no protocol approval from an institutional review board was necessary. Details of the survey methods can be found elsewhere [37]. In adherence with HIV and STI testing guidelines, adolescents who had never had sex were excluded from this analysis.

Measures

Demographics

Demographics include *age* and *race/ethnicity*. Age was assessed with the YRBSS question, "How old are you?" Students could respond "12 years old or younger," "13 years old," "14 years old," "15 years old," "16 years old," "17 years old," or "18 years old or older." Students aged 13 years and younger were excluded from the analysis due to

small sample size and limited exposure to HIV/STI testing [38]. Race/ethnicity was based on a variable created by the CDC in which responses were coded "non-Hispanic Black," "non-Hispanic White," "Hispanic," "Asian," "Native American or Alaskan Native," and "Native Hawaiian or Pacific Islander." The latter three groups were collapsed into an "Other" category for the purposes of sufficient sample size for stepwise modeling.

Outcomes

HIV Testing

The YRBSS asked students "Have you ever been tested for HIV, the virus that causes AIDS? (Do not count tests done if you donated blood.)" Responding "yes" was considered ever having been tested for HIV; responding "no" was considered never having been tested.

STI Testing

The YRBSS asked students "During the past 12 months, have you been tested for a sexually transmitted disease (STD) other than HIV, such as chlamydia or gonorrhea?" Responding "yes" was considered ever having been tested for an STI; responding "no" was considered never having been tested.

Predictors

Sex of Sexual Partners

The YRBSS asked, "During your life, with whom have you had sexual contact?" Students could respond "I have never had sexual contact," "with females," "with males," or "both sexes." YRBSS then created a pre-calculated variable *Sex of sexual partners* which took into consideration the sex of the student and their selection for this question. Resulting categories were "never had sex," "opposite sex only," "same sex only," and "both sexes." Those who never had sex were not included in this analysis.

Number of Sexual Partners

The YRBSS asked, "In the last 3 months, with how many people have you had sexual intercourse?" Students could respond with "I have never had sexual intercourse," "No partners" (treated as the reference category), "One partner," and "More than one partner." The use of this variable in the current analysis was treated as a categorical variable and did not include those who had never had sex.

Condomless Sex

The YRBSS asked, "The last time you had sexual intercourse, did you or your partner use a condom?" Students could respond with "I have never had sexual intercourse," "Yes," and "No." For the purpose of this analysis, individuals who reported never having sexual intercourse were not included.

Drugs or Alcohol Use before Sex

The YRBSS asked, "Did you drink alcohol or use drugs before you had sexual intercourse the last time?" Students could respond with "I have never had sexual intercourse," with possible responses: "Yes," or "No." Those who had never had sexual intercourse were not included in the analysis.

Current Substance Use Frequency

The YRBSS asked participants who had reported ever using these respective substances, "During the past 30 days, on how many days did you have at least one drink of alcohol?" In line with previous literature [39], students were identified as *infrequent alcohol users* if they reported drinking alcohol 0–3 days in the past 30 days; *mild users* if they reported drinking 3–9 days in the past 30 days; and *frequent users* if they reported more than 10 days in the past 30 days. The YRBSS asked the same question of cannabis use and e-cigarette use; the same definitions applied to all classifications of substance use. Each variable was analyzed independently.

Lifetime Cocaine Use

The YRBSS asked, "During your life, how many times have you used any form of cocaine, including powder, crack, or freebase?" Students who reported at least one time were considered to have ever tried an illicit drug and were compared to students who reported zero times.

Lifetime Prescription Pain Medication Misuse

The YRBSS asked, "During your life, how many times have you taken prescription pain medicine without a doctor's prescription or differently than how a doctor told you to use it?" Students who reported at least once were compared to those who reported zero times.

Procedures

Univariate analyses described the distribution of demographics, predictors, and HIV and STI testing. Stepwise

multivariable logistic regression models determined odds of HIV and STI testing (outcomes) stratified by sex (males and females). We were limited to the options for sex provided by the YRBSS. Stepwise modeling consisted of sequentially testing three models. We employed stepwise model selection techniques guided by the Akaike Information Criterion (AIC) to optimize model fit. Model 1 estimated odds of the outcomes by demographics (race/ethnicity and age), and sex behaviors (sex partner type, number of sex partners, drugs and alcohol use before sex, and condom use). Model 2 extended Model 1 by containing demographics, sex behaviors, and additionally including current substance use frequency (past 30 days e-cigarette, alcohol, and cannabis use). Model 3 further extended Model 2 by containing demographics, sex behaviors, current substance use frequency, and additionally including lifetime cocaine use and lifetime prescription drug misuse. Analytic procedures were adapted from Outlaw and colleagues (2022) which explored HIV testing and demographic and behavioral correlates using stepwise regression modeling [3]. The current analysis builds upon these models to include e-cigarette use which rose in prevalence in the years since the analysis of previous YRBSS data (2013 and 2015), focus on frequency of use, and added focus on STI testing using the latest available data. Appropriate sampling weights were applied, and survey estimations were implemented to account for the sampling design [37]. To evaluate multicollinearity within our models, Variance Inflation Factor (VIF) analysis was employed. *P*-values were presented for interval estimates with a lower bound of 1.00. Analyses were conducted using R statistical software version 4.3.1 [40].

Results

The YRBSS 2019–2021 sample of students (total weighted $n = 30{,}909$) had a mean age of 16 years (linearized standard error [SE]: 0.03) and was 51% males and 49% females. White participants formed the majority at 51%, followed by 26% Latino or Hispanic, 12% Black, 5% Multiple, and 6% other ethnicities (including Native American/Alaskan, Native Hawaiian, Pacific Islander, or Asian). Approximately 34% of students identified as having opposite-sex partners, 2% had same-sex partners, and 5% had both, while 45% reported having no sexual intercourse and 14% did not respond. The average number of sexual partners reported was 1 (mean = 0.77, linearized SE: 0.03). In the last three months, 59% reported never having had sexual intercourse, 9% did not have any partners, 17% had one partner, and 4% had more than one partner. For condom use during sex, 17% did not use condoms and 13% did. Drug or alcohol use before sex was reported by 6% of students, whereas 23% did not, 56% had never had sex, and 15% did not respond. About 82% of students reported using e-cigarettes 0–3 days in the past 30 days, 6% reported 3–9 days, and 12% reported more than 10 days. Alcohol use in the past 30 days was reported by 89% for 0–3 days, 9% for 3–9 days, and 2% for more than 10 days. Cannabis use was reported by 88% for 0–3 days, 6% for 3–9 days, and 6% for more than 10 days. Around 97% of the sample never used cocaine and 3% reported usage at least once. Prescription drug misuse was reported by 13% of the students, while 87% reported no misuse. (Table 1).

Table 2 displays the odds of HIV testing for males in the sample. In Model 1, compared to White males, the odds of STI testing were 1.05 times greater for Black males (95% Confidence Interval [CI]: 1.00, 1.10) and 1.07 times greater for Multiracial males (95% Confidence Interval [CI]: 1.00, 1.16), however, the *p*-values for these estimates were not significant. The odds of HIV testing were 1.01 times greater for older male students (95% CI: 1.00, 1.02; $p = 0.026$). Males who reported having sexual partners of both the same and opposite sex had 1.14 times greater odds of HIV testing compared to males who only reported having sexual partners of the opposite sex (95% CI: 1.03, 1.26). The odds of HIV testing were 1.14 times greater for those reporting increasing number of sex partners (95% CI: 1.07, 1.21). Model 2 saw similar results to Model 1. Age, sex of sexual partner, and number of sex partners remained significant in all three models.

Table 3 displays the odds of HIV testing for females in the sample. In Model 1, the odds of HIV testing were 1.02 times greater for older female students (95% CI: 1.01, 1.04). The odds of HIV testing were 1.06 times greater for those reporting increasing number of sex partners (95% CI: 1.01, 1.12). Females who reported using drugs or alcohol before their last sexual encounter were 1.09 times greater odds of HIV testing (95% CI: 1.04, 1.14). The odds of HIV testing were 0.92 times lower for those reporting condomless sex (95% CI: 0.88, 0.96). Model 2 saw similar results to Model 1; however, odds for drugs or alcohol use before sex was no longer significant; in addition, odds of HIV testing were 0.92 times lower for female students reporting "Other" race (i.e., Native American, Alaskan Native, Native Hawaiian, Pacific Islander, or Asian) (95% CI: 0.86, 0.98). Additionally, female students who reported 3–9 days of cannabis use in the past 30 days had 1.08 greater odds (95% CI: 1.01, 1.15) of HIV testing and 1.12 times greater odds for female students reporting more than 10 days of cannabis use in the past 30 days (95% CI: 1.04, 1.20). Model 3 had similar results (apart from sex of sex partners which lost significance in Model 3); in addition, female students reporting lifetime cocaine use had 1.15 times greater odds of HIV testing (95% CI: 1.04, 1.28) and female students

Table 1 Demographic characteristics of Youth in the 2019–2021 YRBS (unweighted $n = 30{,}909$, weighted $n = 30{,}909$)

	Weighted mean or *n*	SE or Weighted %
Sex		
Male	15,645	51.2
Female	14,891	48.8
Race/ethnicity		
White	15,318	50.9
Black	3,653	12.1
Latino/Hispanic	7,735	25.7
Multiple	1,551	5.2
Native American/Alaskan, Native Hawaiian, Pacific Islander, or Asian	1,830	6.1
Age (years) (weighted mean (SE))	15.83	0.03
Sex partner type	14,003	45.3
Never had sex		
Opposite	10,420	33.7
Same	605	2.0
Both	1,446	4.7
Missing/nonresponse	4,434	14.3
Number of sex partners (weighted mean (SE))	0.77	0.03
Number of sex partners		
Never had sex	18,363	59.4
None in the last 3 months	2,707	8.8
One partner in the last 3 months	5,263	17.0
More than 1 partner in the last 3 months	1,264	4.1
Missing/nonresponse	3,313	10.7
Condomless sex	18,366	59.4
Never had sex	5,119	16.6
Yes	4,045	13.1
No	3,380	10.9
Missing/nonresponse	17,299	56.0
Drugs or alcohol use before sex	1,701	5.5
Never had sex	7,212	23.3
Yes	4,697	15.2
No		
Missing/nonresponse		
Frequency of current electronic cigarette use		
0–2 days in the past 30 days	23,668	82.1
3–9 days in the past 30 days	1,692	5.9
More than 10 days in the past 30 days	3,467	12.0
Frequency of current alcohol use		
0–2 days in the past 30 days	25,560	88.5
3–9 days in the past 30 days	2,627	9.1
More than 10 days in the past 30 days	685	2.4
Frequency of current cannabis use		
0–2 days in the past 30 days	26,621	88
3–9 days in the past 30 days	1,902	6.3
More than 10 days in the past 30 days	1,724	5.7
Lifetime cocaine use		
0 times	27,268	96.9
At least once	878	3.1
Lifetime prescription drug misuse		
0 times	25,831	86.9
At least once	3,897	13.1
Missing observations presented if missing > 10%		
Abbreviation: SE, standard error.		

Table 2 Odds of testing for HIV infection for males in the 2019 and 2021 YRBS cycles using stepwise modeling

	OR (95% CI)		
	M1 Characteristics (weighted $n = 4{,}985$)	M2 Characteristics + Alcohol + Cannabis + Vaping (weighted $n = 4{,}031$)	M3 Characteristics + Alcohol, Cannabis, + Vaping + Illicit Cocaine Use + Prescription Drug Misuse (weighted $n = 3{,}890$)
Race/ethnicity			
White	Ref.	Ref.	Ref.
Black	1.05 (1.00, 1.10) ($p = 0.060$)	1.03 (0.98, 1.08)	1.03 (0.98, 1.08)
Latino/Hispanic	1.03 (0.98, 1.09)	1.02 (0.97, 1.08)	1.02 (0.96, 1.08)
Multiple	1.07 (1.00, 1.16) ($p = 0.070$)	1.09 (1.00, 1.19) ($p = 0.059$)	1.09 (1.00, 1.19) ($p = 0.060$)
Other	1.02 (0.93, 1.12)	1.00 (0.91, 1.10)	1.00 (0.91, 1.11)
Age	**1.01 (1.00, 1.02) ($p = 0.026$)**	**1.01 (1.00, 1.03) ($p = 0.032$)**	**1.02 (1.00, 1.03) ($p = 0.029$)**
Sex of sexual partner			
Opposite	Ref.	Ref.	Ref.
Same	1.05 (0.96, 1.16)	1.07 (0.96, 1.19)	1.07 (0.96, 1.19)
Both	**1.14 (1.03, 1.26)**	**1.16 (1.04, 1.30)**	**1.16 (1.04, 1.30)**
Number of sex partners in the past 3 months			
No partners	Ref.	Ref.	Ref.
One partner	1.03 (0.99, 1.06)	1.02 (0.99, 1.06)	1.02 (0.98, 1.06)
More than one partner	**1.14 (1.07, 1.21)**	**1.13 (1.06, 1.21)**	**1.13 (1.06, 1.22)**
Condomless sex			
No	Ref.	Ref.	Ref.
Yes	1.00 (0.97, 1.03)	1.03 (0.99, 1.06)	1.03 (0.99, 1.06)
Drugs or alcohol use before sex			
No	Ref.	Ref.	Ref.
Yes	1.00 (0.97, 1.04)	0.99 (0.94, 1.04)	0.99 (0.94, 1.04)
Frequency of current electronic cigarette use			
0–3 days in the past 30 days		Ref.	Ref.
3–9 days in the past 30 days		0.95 (0.89, 1.01)	0.94 (0.89, 1.01)
More than 10 days in the past 30 days		0.97 (0.92, 1.02)	0.97 (0.92, 1.02)
Frequency of current alcohol use			
0–3 days in the past 30 days		Ref.	Ref.
3–9 days in the past 30 days		1.01 (0.95, 1.07)	1.01 (0.94, 1.07)
More than 10 days in the past 30 days		1.05 (0.97, 1.14)	1.05 (0.97, 1.14)
Frequency of current cannabis use			
0–3 days in the past 30 days		Ref.	Ref.
3–9 days in the past 30 days		1.02 (0.96, 1.07)	1.02 (0.97, 1.08)
More than 10 days in the past 30 days		1.06 (1.00, 1.12) ($p = 0.053$)	1.05 (0.99, 1.12)
Lifetime cocaine use			
No			Ref.
Yes			0.98 (0.92, 1.05)
Lifetime prescription drug misuse			
No			Ref.
Yes			1.03 (0.98, 1.09)

Notes: Models were built based on stepwise modeling; M1 model contains participant demographic characteristics including race/ethnicity and age, and sexual behaviors including sex of sexual partner, number of sex partners in the last three months, condomless sex, and drugs or alcohol before sex. M2 model contains substance use predictors (frequency of current alcohol, cannabis, and e-cigarette use) in addition to the predictors from the previous model. M3 model contains illicit substance use behaviors (cocaine use and prescription drug misuse) in addition to the predictors from the previous models

Bolded estimates indicate statistical significance ($p < 0.05$)

Table 3 Odds of testing for HIV infection for females in the 2019 and 2021 YRBSS cycles using stepwise modeling

	OR (95% CI)		
	M1 Characteristics (weighted $n = 4{,}629$)	M2 Characteristics + Alcohol + Cannabis + Vaping (weighted $n = 3{,}821$)	M3 Characteristics + Alcohol, Cannabis, + Vaping + Illicit Cocaine Use + Prescription Drug Misuse (weighted $n = 3{,}658$)
Race/ethnicity			
White	Ref.	Ref.	Ref.
Black	1.04 (0.97, 1.12)	1.03 (0.96, 1.12)	1.03 (0.96, 1.12)
Latino/Hispanic	1.01 (0.96, 1.07)	1.00 (0.95, 1.06)	1.00 (0.95, 1.05)
Multiple	1.01 (0.92, 1.11)	1.00 (0.90, 1.11)	1.01 (0.91, 1.12)
Other	0.96 (0.88, 1.05)	**0.92 (0.86, 0.98)**	**0.92 (0.86, 0.98)**
Age	**1.02 (1.01, 1.04)**	1.03 (1.01, 1.05)	**1.03 (1.02, 1.05)**
Sex of sexual partner			
Opposite	Ref.	Ref.	Ref.
Same	1.03 (0.94, 1.12)	1.01 (0.91, 1.11)	1.00 (0.90, 1.10)
Both	**1.06 (1.01, 1.12)**	**1.07 (1.00, 1.14)** (***p* = 0.042**)	1.05 (0.99, 1.12)
Number of sex partners in the past 3 months			
No partners	Ref.	Ref.	Ref.
One partner	1.00 (0.96, 1.05)	0.98 (0.94, 1.02)	0.98 (0.93, 1.02)
More than one partner	1.06 (0.98, 1.14)	1.03 (0.95, 1.11)	1.03 (0.95, 1.11)
Condomless sex			
No	Ref.	Ref.	Ref.
Yes	**0.92 (0.88, 0.96)**	**0.93 (0.89, 0.96)**	**0.93 (0.90, 0.97)**
Drugs or alcohol use before sex			
No	Ref.	Ref.	Ref.
Yes	**1.09 (1.04, 1.14)**	1.03 (0.97, 1.10)	1.03 (0.97, 1.10)
Frequency of current electronic cigarette use			
0–3 days in the past 30 days		Ref.	Ref.
3–9 days in the past 30 days		0.96 (0.90, 1.03)	0.95 (0.89, 1.02)
More than 10 days in the past 30 days		1.02 (0.96, 1.08)	1.00 (0.94, 1.06)
Frequency of current alcohol use			
0–3 days in the past 30 days		Ref.	Ref.
3–9 days in the past 30 days		0.98 (0.93, 1.03)	0.97 (0.92, 1.02)
More than 10 days in the past 30 days		1.04 (0.92, 1.17)	1.01 (0.89, 1.15)
Frequency of current cannabis use			
0–3 days in the past 30 days		Ref.	Ref.
3–9 days in the past 30 days		**1.08 (1.01, 1.15)**	**1.08 (1.01, 1.15)**
More than 10 days in the past 30 days		**1.12 (1.04, 1.20)**	**1.11 (1.04, 1.19)**
Lifetime cocaine use			
No			Ref.
Yes			**1.15 (1.04, 1.28)**
Lifetime prescription drug misuse			
No			Ref.
Yes			1.05 (1.00, 1.11) ($p = 0.081$)

Notes: Models were built based on stepwise modeling; M1 model contains participant demographic characteristics including race/ethnicity and age, and sexual behaviors including sex of sexual partner, number of sex partners in the last three months, condomless sex, and drugs or alcohol before sex. M2 model contains substance use predictors (frequency of current alcohol, cannabis, and e-cigarette use) in addition to the predictors from the previous model. M3 model contains illicit substance use behaviors (cocaine use and prescription drug misuse) in addition to the predictors from the previous models

Bolded estimates indicate statistical significance ($p < 0.05$)

reporting lifetime prescription drug misuse had 1.05 times greater odds of HIV testing (95% CI: 1.00, 1.11), however, this was not statistically significant ($p = 0.081$).

Table 4 displays the odds of STI testing for males in the sample. In Model 1, compared to White males, the odds of STI testing were 1.08 times greater for Black males (95% Confidence Interval [CI]: 1.03, 1.12), 1.06 times greater for Latino/Hispanic males (95% CI: 1.01, 1.10), and 1.14 times greater for Multiracial males (95% CI: 1.05, 1.23). The odds of STI testing were 1.01 times greater for older male students (95% CI: 1.00, 1.02, $p = 0.019$). Males who reported having sexual partners of both the same and opposite sex had 1.11 times greater odds of STI testing compared to males who only reported having sexual partners of the opposite sex (95% CI: 1.02, 1.22). The odds of STI testing were 1.15 times greater for those reporting increasing number of sex partners (95% CI: 1.09, 1.22). Males who reported using drugs or alcohol before their last sexual encounter were 1.04 times greater odds of STI testing (95% CI: 1.01, 1.08). Model 2 saw similar results to Model 1, however odds for Latino/Hispanic males and drug or alcohol use before sex were no longer significant. Substance use variables were not statistically significant. Age and sex of sexual partner remained significant in all three models; cocaine use, and prescription drug misuse were not statistically significant in Model 3.

Table 5 displays the odds of STI testing for females in the sample. In Model 1, the odds of STI testing were 1.05 times greater for older female students (95% CI: 1.03, 1.07). No associations were found for race/ethnicity among female students. The odds of STI testing were 1.10 times greater for those reporting increasing number of sex partners (95% CI: 1.02, 1.18). Females who reported using drugs or alcohol before their last sexual encounter were 1.05 times greater odds of STI testing (95% CI: 1.00, 1.10, $p = 0.042$). The odds of STI testing were 0.91 times lower for those reporting no condom use during their last sexual intercourse (95% CI: 0.87, 0.95). Model 2 saw similar results to Model 1; however, odds for number of sexual partners and drugs or alcohol use before sex were no longer significant; in addition, odds of STI testing were 1.08 times greater for female students reporting 3–9 days of cannabis use in the past 30 days (95% CI: 1.00, 1.17, $p = 0.049$) and 1.12 times greater for female students reporting more than 10 days of cannabis use in the past 30 days (95% CI: 1.03, 1.21). Age and condomless sex remained significant in all three models; frequent (> 10 days) use of cannabis use remained significant in models 2 and 3.

Discussion

This study examined associations between unhealthy sexual and substance use behaviors and HIV/STI testing among a national sample of adolescents. There were significant differences in HIV/STI testing regarding race and sex in the sample. Among adolescent males, age, number of sexual partners, and having sexual partners of both sexes were associated with increased odds of HIV and STI testing; Black, Latino/Hispanic, and Multiracial identity were associated with increased odds of STI testing. Key findings for females in this study were "Other" racial identity (i.e., Native American/Alaskan, Native Hawaiian, Pacific Islander, or Asian) associated with decreased odds of HIV testing, having sexual partners of both sexes, mild cannabis use, and lifetime cocaine use associated with increased odds of HIV testing; age and frequent cannabis use were both associated with increased odds of HIV and STI testing, and condomless sex associated with decreased odds of HIV and STI testing.

Sexual Health Behaviors

In the analysis, we had mixed findings for HIV and STI testing odds among adolescents engaging in unhealthy sexual behaviors linked to increased HIV and STI incidence. The association between the number of sexual partners and increased odds of HIV and STI testing aligns with previous literature, reflecting public health messaging around sexual behavior and HIV and STI testing to be fairly accepted by adolescents [2, 19]. The finding of males reporting sexual partners of both sexes having increased odds of HIV and STI testing is a marked improvement from a previous study using YRBSS data from 2005 to 2013 illustrating a small proportion of sexual minority adolescent males reporting HIV or STI testing [41]. These results imply public health successes in sexual health behavior messaging towards adolescents. However, the finding of condomless sex associated with decreased odds of HIV and STI testing among adolescent females is contrary to previous literature [19, 42]. This raises questions on the possible barriers that arise for adolescent females and testing for HIV and STIs. One possible barrier for adolescent females could involve the power dynamics of contraception control in the female's relationship [42]. This finding warrants further exploration of this phenomenon, as this is concerning, and future research could aid in the development of sensitive interventions geared to increase HIV and STI testing rates among adolescent females.

Table 4 Odds of testing for sexually transmitted infections (STIs) for males in the 2019 and 2021 YRBSS cycles using stepwise modeling

	OR (95% CI)		
	M1 Characteristics (weighted $n = 4{,}837$)	M2 Characteristics + Alcohol + Cannabis + Vaping (weighted $n = 3{,}961$)	M3 Characteristics + Alcohol, Cannabis, + Vaping + Illicit Cocaine Use + Prescription Drug Misuse (weighted $n = 3{,}849$)
Race/ethnicity			
White	Ref.	Ref.	Ref.
Black	**1.08 (1.03, 1.12)**	**1.06 (1.01, 1.10)**	**1.06 (1.01, 1.11)**
Latino/Hispanic	**1.06 (1.01, 1.10)**	1.04 (0.99, 1.09)	1.04 (0.99, 1.10)
Multiple	**1.14 (1.05, 1.23)**	**1.13 (1.05, 1.21)**	**1.13 (1.05, 1.21)**
Other	1.00 (0.93, 1.06)	0.97 (0.91, 1.04)	0.97 (0.90, 1.04)
Age	**1.01 (1.00, 1.02) ($p = 0.019$)**	**1.02 (1.01, 1.03)**	**1.02 (1.01, 1.03)**
Sex of sexual partner			
Opposite	Ref.	Ref.	Ref.
Same	1.05 (0.96, 1.15)	1.07 (0.97, 1.17)	1.07 (0.97, 1.18)
Both	**1.11 (1.02, 1.22)**	**1.13 (1.03, 1.25)**	**1.13 (1.02, 1.24)**
Number of sex partners in the past 3 months			
No partners	Ref.	Ref.	Ref.
One partner	1.02 (0.99, 1.05)	1.02 (0.99, 1.05)	1.02 (0.99, 1.05)
More than one partner	**1.15 (1.09, 1.22)**	**1.12 (1.06, 1.19)**	**1.12 (1.05, 1.19)**
Condomless sex			
No	Ref.	Ref.	Ref.
Yes	1.00 (0.98, 1.03)	1.03 (0.99, 1.06)	1.03 (1.00, 1.06)
Drugs or alcohol use before sex			
No	Ref.	Ref.	Ref.
Yes	**1.04 (1.01, 1.08)**	1.02 (0.98, 1.06)	1.02 (0.97, 1.07)
Frequency of current electronic cigarette use			
0–3 days in the past 30 days		Ref.	Ref.
3–9 days in the past 30 days		0.96 (0.90, 1.03)	0.97 (0.90, 1.04)
More than 10 days in the past 30 days		0.98 (0.94, 1.02)	0.98 (0.94, 1.02)
Frequency of current alcohol use			
0–3 days in the past 30 days		Ref.	Ref.
3–9 days in the past 30 days		1.00 (0.96, 1.06)	1.00 (0.95, 1.06)
More than 10 days in the past 30 days		1.09 (0.99, 1.19)	1.07 (0.97, 1.18)
Frequency of current cannabis use			
0–3 days in the past 30 days		Ref.	Ref.
3–9 days in the past 30 days		1.01 (0.96, 1.07)	1.00 (0.95, 1.06)
More than 10 days in the past 30 days		1.04 (0.99, 1.09)	1.03 (0.98, 1.08)
Lifetime cocaine use			
No			Ref.
Yes			1.04 (0.98, 1.11)
Lifetime prescription drug misuse			
No			Ref.
Yes			1.01 (0.97, 1.06)

Notes: Models were built based on stepwise modeling; M1 model contains participant demographic characteristics including race/ethnicity and age, and sexual behaviors including sex of sexual partner, number of sex partners in the last three months, condomless sex, and drugs or alcohol before sex. M2 model contains substance use predictors (frequency of current alcohol, cannabis, and e-cigarette use) in addition to the predictors from the previous model. M3 model contains illicit substance use behaviors (cocaine use and prescription drug misuse) in addition to the predictors from the previous models

Bolded estimates indicate statistical significance ($p < 0.05$)

Table 5 Odds of testing for sexually transmitted infections (STIs) for females in the 2019 and 2021 YRBSS cycles using stepwise modeling

	OR (95% CI)		
	M1 Characteristics (weighted $n = 4,494$)	M2 Characteristics + Alcohol + Cannabis + Vaping (weighted $n = 3,745$)	M3 Characteristics + Alcohol, Cannabis, + Vaping + Illicit Cocaine Use + Prescription Drug Misuse (weighted $n = 3,614$)
Race/ethnicity			
White	Ref.	Ref.	Ref.
Black	1.05 (0.97, 1.14)	1.09 (1.00, 1.19) ($p = 0.066$)	1.09 (1.00, 1.19) ($p = 0.064$)
Latino/Hispanic	1.00 (0.95, 1.05)	1.01 (0.96, 1.06)	1.01 (0.96, 1.06)
Multiple	1.00 (0.92, 1.08)	0.98 (0.91, 1.07)	0.99 (0.91, 1.08)
Other	0.93 (0.85, 1.02)	0.95 (0.86, 1.04)	0.95 (0.86, 1.05)
Age	**1.05 (1.03, 1.07)**	**1.05 (1.03, 1.08)**	**1.05 (1.03, 1.08)**
Sex of sexual partner			
Opposite	Ref.	Ref.	Ref.
Same	0.98 (0.90, 1.06)	0.97 (0.88, 1.07)	0.97 (0.88, 1.07)
Both	1.03 (0.98, 1.08)	1.02 (0.96, 1.08)	1.01 (0.95, 1.08)
Number of sex partners in the past 3 months			
No partners	Ref.	Ref.	Ref.
One partner	1.01 (0.97, 1.05)	0.99 (0.95, 1.03)	0.98 (0.94, 1.02)
More than one partner	**1.10 (1.02, 1.18)**	1.07 (0.98, 1.17)	1.06 (0.97, 1.16)
Condomless sex			
No	Ref.	Ref.	Ref.
Yes	**0.91 (0.87, 0.95)**	**0.92 (0.88, 0.97)**	**0.93 (0.89, 0.98)**
Drugs or alcohol use before sex			
No	Ref.	Ref.	Ref.
Yes	**1.05 (1.00, 1.10) ($p = 0.042$)**	0.98 (0.94, 1.03)	0.98 (0.93, 1.04)
Frequency of current electronic cigarette use			
0–3 days in the past 30 days		Ref.	Ref.
3–9 days in the past 30 days		1.00 (0.94, 1.07)	1.01 (0.95, 1.08)
More than 10 days in the past 30 days		1.05 (0.99, 1.12)	1.04 (0.98, 1.11)
Frequency of current alcohol use			
0–3 days in the past 30 days		Ref.	Ref.
3–9 days in the past 30 days		0.98 (0.94, 1.03)	0.97 (0.93, 1.02)
More than 10 days in the past 30 days		1.05 (0.96, 1.16)	1.03 (0.93, 1.14)
Frequency of current cannabis use			
0–3 days in the past 30 days		Ref.	Ref.
3–9 days in the past 30 days		**1.08 (1.00, 1.17) ($p = 0.049$)**	1.08 (1.00, 1.18) ($p = 0.066$)
More than 10 days in the past 30 days		**1.12 (1.03, 1.21)**	**1.12 (1.03, 1.21)**
Lifetime cocaine use			
No			Ref.
Yes			1.07 (0.96, 1.20)
Lifetime prescription drug misuse			
No			Ref.
Yes		`	1.02 (0.97, 1.09)

Notes: Models were built based on stepwise modeling; M1 model contains participant demographic characteristics including race/ethnicity and age, and sexual behaviors including sex of sexual partner, number of sex partners in the last three months, condomless sex, and drugs or alcohol before sex. M2 model contains substance use predictors (frequency of current alcohol, cannabis, and e-cigarette use) in addition to the predictors from the previous model. M3 model contains illicit substance use behaviors (cocaine use and prescription drug misuse) in addition to the predictors from the previous models

Bolded estimates indicate statistical significance ($p < 0.05$)

Sex Differences in Substance Use

Findings from our analysis reveal an interesting pattern indicating that adolescent females engaging in substance use and potential polysubstance use have increased odds of HIV and STI testing where males do not. For example, among adolescent females in the sample, frequent (> 9 days in past 30) cannabis use remained associated with a greater odd of STI testing through iterations of stepwise modeling. For HIV testing, mild and frequent cannabis use, and lifetime cocaine use were associated with higher odds of testing, however, to our knowledge, limited studies have investigated the associations between cannabis or cocaine use and STI testing [3]. A previous study using 2005 to 2011 YRBSS data, reflecting a consistent trend between these substances and HIV testing [3]. Since cannabis use is associated with lower condom use among adolescents, we suspect adolescent females engaging in these behaviors are more likely to be knowledgeable of these risks and may have greater engagement with healthcare that offers HIV and STI tests [43, 44]. However, our finding that condomless sex is associated with lower odds of testing even after adjusting for cannabis use raises a contradiction. Several researchers suggest that higher odds of STI testing among adolescent females may be attributed to standard reproductive and gynecological care for this population [45, 46]. However, this does not provide a comprehensive understanding of the pattern of substance use. Further research should continue to elucidate these substance-specific patterns found in order to better tailor HIV and STI testing promotion interventions. Our findings highlight the strong association between engaging in sexual health behaviors and the use of substances with HIV and STI testing. Understanding this co-occurrence is crucial for developing HIV and STI testing-focused interventions for adolescents as they continue to develop and negotiate autonomy over their health and behaviors.

Sex and Racial Disparities

Contextualizing these results within a frame that considers the intersectional impact of race and sex provides invaluable insights for future application and research. Males who were older and self-identified as Black, Latino, and Multiple races had higher odds of STI testing but this effect was not found for females. This could indicate a combination of higher exposure to sexual and reproductive health messages due to race, developmental stage, and urgency due to the historical disproportionate impact of the HIV/AIDS epidemic on gay, bisexual and questioning men [7, 47, 48]. In contrast, adolescent females identifying as Native American/Alaskan, Native Hawaiian, Pacific Islander, or Asian reported significantly lower odds of HIV testing compared to adolescents identifying as non-Hispanic White, highlighting potential barriers such as poor sexual and reproductive health access or pervasive stigma and misconceptions [49]. These findings are not only supported by the literature but also parallel other recent sexual reproductive health prevention trends around higher testing for certain minoritized groups. Results from a 2024 study utilizing IBM MarketScan Medicaid claims data found that more chlamydia and gonorrhea (two of the most common STIs) tests were ordered for Black youth than their White and Hispanic counterparts [50]. These findings underscore the need for more culturally sensitive interventions which recognize the racialized and gendered dynamics that may limit HIV/STI testing to improve rates among these communities of adolescents [3]. Additionally, while the study was not able to include the experiences of minoritized intersex youth, these findings encourage additional researcher and practitioner efforts in understanding how they experience and navigate HIV/STI testing.

Recommendations

These racial and sex differences in testing behaviors may have implications for culturally competent, sex- and gender-responsive intervention and care. While sexual orientation was not explicitly included in the present analysis (though sex of sexual partners was included), given the prevalence of HIV among Black men in the U.S. who have sex with men (MSM) and the continued public health efforts towards destigmatization and community engaged-education, sexual orientation should be explored in a future analysis [51]. However, as there has been a focus on the sexual health practices of this group, researchers and practitioners may have unintentionally rendered invisible the needs of/outreach efforts to other groups such as female Native American, Alaskan Native, Native Hawaiian, Pacific Islander, or Asian adolescents. Additionally, our results showing substance use and age were associated with increased odds of STI testing may align with current literature supporting current sex-based medical bias. Yumori and colleagues found in their 2021 study that women were less likely to be adequately screened for HIV (15.1% vs. 25.8%) and Liddon and colleagues found in their 2022 study that younger girls were less likely to be properly screened for STIs [42, 52]. Practitioners guided by biases may overlook the need to conduct routine screenings for younger female identified adolescents unless there are evident risk factors such as substance use. Younger females may also feel more uncomfortable disclosing their needs around sexual reproductive health due to gendered and racist stereotypes surrounding the sexuality of certain groups. These findings highlighting how, while we may have made strides in addressing some of

the disparities in consistent, effective sexual health outreach and educations, future research should continue to examine these sex and substance use interaction patterns to better tailor HIV and STI testing promotion interventions.

Strengths & Limitations

Findings must be considered within the context of a few limitations. While this cross-sectional study provides information on correlates associated with lifetime STI and HIV testing, possible confounding factors were not assessed, and causal inference cannot be drawn. National YRBSS data are representative of public and private school students in grades 9–12 in the 50 states and the District of Columbia. Thus, results are not generalizable to adolescents who do not attend high school and may face even greater barriers to STI and HIV testing than their peers. Alcohol, cannabis, and e-cigarette use frequencies were assessed in the past 30 days, potentially excluding adolescents who previously engaged in the use of these substances. Frequencies of cocaine use and prescription pain medicine misuse were assessed in the student's lifetime, potentially grouping students who tried either substance once and never again with students who currently engage in use of either substance. Outcome measures were limited to single items assessing whether students had ever been tested for HIV or have been tested for STIs in the past year. Disruptions in access to sexual health services caused by the COVID-19 pandemic likely affected HIV and STI testing results, and STI testing results in particular [53]. The binary assessment of sex required transgender adolescents to choose between disclosing their sex assigned at birth and current gender identity and provided nonbinary adolescents with no means of expressing their identity. All measures were self-reported and vulnerable to recall and social desirability biases, which may have affected estimates of sexual health behaviors, substance use, and HIV and STI testing. Additionally, while it is always our goal to involve youth in research pertaining to their health outcomes, this analysis was not part of a larger funded study and therefore authors were restricted in the use of an advisory board to receive feedback regarding the analysis and interpretation of the results. Regarding the statistical approach, moderate multicollinearity was detected in the adolescent male statistical models between race and other variables, as indicated by elevated Variance Inflation Factors (VIFs). This finding points to a potential overlap in the explanatory capacity of these variables. To ensure transparency in our analytical procedures, this potential multicollinearity has been flagged in this section, and the detailed VIF results are submitted as supplementary material. While this did not deter our analytical goals, conclusions drawn from the affected models should be interpreted with caution. Further research could explore more sophisticated modeling strategies to refine these estimates. Additionally, the close AIC values between two sequential models (e.g., Model 2 and Model 3 for STI in males) raise considerations about the trade-off between model complexity and fit. Such observations are crucial for discussing the model selection process, emphasizing that more complex models do not always equate to significantly better model performance. Additionally, there were several interval estimates that, while not crossing 1.00, had a lower bound of 1.00. In these cases, *p*-values were presented upon which significance was interpreted. Despite these limitations, the present study has notable strengths for examining correlates of HIV and STI testing among adolescents. The population-based sample included nationally representative data, increasing the generalizability of results. The sample size also enabled adequately powered analyses to evaluate sex differences in associations between demographics, sexual health behaviors, substance use, and HIV/STI testing.

Implications

These findings highlight the importance of the role of how HIV and STI testing patterns are socially and structurally racialized, as well as the nuance of substance use behaviors that vary between the male and female adolescents in this sample. In addition to the need for scaling HIV and STI testing for young people to prevent new cases of HIV and STIs, there is a need for tailored services that are more accessible, confidential, and culturally sensitive. One of which are optimizing school clinics as sites for investment in HIV preventative service, which has been shown to be a feasible and acceptable outlet for adolescents to receive sexual health promotion services [3, 54–56]. Such programming has also been beneficial in streamlining routine testing and care but also reduced barriers (e.g., geographic access, timely and rapid testing, In accordance to the literature, adolescents who reported using substances were highly associated with increased HIV and STI testing [43, 57, 58]. It is possible that they are also likely to experience more frequent encounters with healthcare providers, harm reduction, and other community programs. Thus, it is also necessary that continued investment in these points of service remain upkept to ensure routine HIV and STI testing is maintained for adolescents. Our findings regarding the associations between multiple sex partners and HIV testing are consistent with previous literature on polyamorous and non-monogamous relationships [59–61]. These patterns show that adolescents who engage in sex with multiple partners may feel more empowered to negotiate safer sex practices but also aware of the importance of routine HIV and STI testing. However, these forms of relationships outside of the socially normalized monogamous relationships remain heavily stigmatized

amongst healthcare providers, despite previous research that show that individuals in monogamous relationships do not necessarily result in less risk of acquiring HIV or STIs [60–62]. Therefore, HIV and STI testing efforts should also encompass broader models beyond traditional sexual and romantic relationships.

Conclusion

In conclusion, data from the YRBSS 2019 and 2021 cycles provides important insight on the HIV and STI testing behaviors of adolescents. Findings underscore the intricate connection between substance use, other sexual health behaviors, and HIV and STI testing, pointing to the need for tailored interventions that consider the nuanced impact of risk among this population.

Supplementary Information The online version contains supplementary material available at https://doi.org/10.1007/s10461-024-04575-w.

Funding No funding was acquired for this study. The fifth author is supported by the National Institute on Drug Abuse (T32DA019426).

Declarations

Research Involving Human Participants and/or Animals This was secondary analysis; details about the study protocol can be found at https://www.cdc.gov/healthyyouth/data/yrbs/index.htm.

Informed Consent Data for this study are secondary and publicly available; informed consent was acquired in the original study.

Competing Interests Authors have no conflicts of interest to disclose.

References

1. Society for Adolescent, H. and, Medicine. Improving outcomes for adolescents and young adults living with HIV. J Adolesc Health. 2023;73(3):605–9.
2. Cuffe KM, et al. Sexually transmitted infection testing among adolescents and young adults in the United States. J Adolesc Health. 2016;58(5):512–9.
3. Outlaw AY, et al. Student characteristics and substance use as predictors of self-reported HIV testing: the youth risk behavior survey (YRBS) 2013–2015. AIDS Care. 2022;34(6):708–16.
4. Pleasure ZH, et al. Patterns in receipt and source of STI Testing among Young people in the United States, 2013–2019. J Adolesc Health. 2022;71(5):642–5.
5. Prevention CfDC. *Reversing the Rise in STIs: Integrating Services to Address the Syndemic of STIs, HIV, Substance Use, and Viral Hepatitis.*
6. Adebayo OW, Gonzalez-Guarda RM. Factors Associated with HIV Testing in Youth in the United States: an integrative review. J Assoc Nurses AIDS Care. 2017;28(3):342–62.
7. Fast, Facts.: *HIV in the US by Age*. 2024; https://www.cdc.gov/hiv/data-research/facts-stats/age.html
8. Grossman JM et al. Father-Teen Talks about Sex and Teens' Sexual Health: The Role of Direct and Indirect Communication. Int J Environ Res Public Health, 2021. 18(18).
9. Prevention C. f.D.C.a., *Diagnoses of HIV Infection in the United States and Dependent Areas, 2021.* 2023.
10. Gant Z, et al. Trends in HIV care outcomes among adults and adolescents in the U.S. South, 2015–2019. Ann Epidemiol. 2022;71:15–22.
11. Evans R, et al. Association of Sexual Health Interventions with Sexual Health Outcomes in Black adolescents: a systematic review and Meta-analysis. JAMA Pediatr. 2020;174(7):676–89.
12. Collins PH. *Black feminist thought in the matrix of domination.* Black feminist thought: Knowledge, consciousness, and the politics of empowerment, 1990. 138(1990): pp. 221–238.
13. Bowleg L. The problem with the phrase women and minorities: intersectionality—an important theoretical framework for public health. Am J Public Health. 2012;102(7):1267–73.
14. Berger MT. Workable sisterhood: the political journey of Stigmatized Women with HIV/AIDS. Princeton University Press; 2010.
15. Levy ME, et al. Understanding structural barriers to Accessing HIV Testing and Prevention Services among Black Men Who Have Sex with men (BMSM) in the United States. AIDS Behav. 2014;18(5):972–96.
16. Allan-Blitz LT, Mena LA, Mayer KH. The ongoing HIV epidemic in American youth: challenges and opportunities. Mhealth. 2021;7:33.
17. Prevention C. f.D.C.a., *Which STD tests should I get?* 2021.
18. Gao TY, et al. Risk factors for self-report of not receiving an HIV test among adolescents in NYC with a history of sexual intercourse, 2013 YRBS. Vulnerable Child Youth Stud. 2017;12(4):277–91.
19. Coeytaux K, Kramer MR, Sullivan PS. HIV testing among United States high school students at the state and national level, Youth Risk Behavior Survey 2005–2011. Springerplus. 2014;3:202.
20. Sauter SR, et al. Sexual networks and STI Infection among Young Black Men Who Have Sex with Women in a Southern U.S. City. J Adolesc Health. 2023;72(5):730–6.
21. Starling R, et al. Testing a risky sex behavior intervention pilot website for adolescents. Calif J Health Promot. 2014;12(3):24–34.
22. Yoon S, Voith LA, Kobulsky JM. Gender differences in pathways from child physical and sexual abuse to adolescent risky sexual behavior among high-risk youth. J Adolesc. 2018;64:89–97.
23. *Youth Risk Behavior Survey: Data Summary & Trends Report 2011–2021*. 2023, Centers for Disease Control and Prevention.
24. Mahat G, Kelly S. Factors affecting risk-taking behaviors among sexually active adolescents tested for HIV/STD. Public Health Nurs. 2023;40(4):550–5.
25. Opara I, et al. The Association between racial attitudes, Alcohol Use and Mood disorders among Black adolescents. J Prev. 2022;2023(441):p85–104.
26. Garcia TA, et al. Growing up, hooking up, and drinking: a review of uncommitted sexual Behavior and its Association with Alcohol Use and related consequences among adolescents and young adults in the United States. Front Psychol. 2019;10:1872.
27. Chadi N, Li G, Hadland SE. Adverse school outcomes and risky sexual health behaviors among high school students with e-cigarette and marijuana use. Volume 56. Substance use & misuse; 2021. pp. 517–21. 4.
28. Chernick LS, et al. Sex without contraceptives in a multicenter study of adolescent emergency department patients. Acad Emerg Med. 2020;27(4):283–90.
29. Demissie Z et al. Adolescent risk behaviors and use of electronic vapor products and cigarettes. Pediatrics, 2017. 139(2).
30. Liu K, et al. Prescription drug monitoring programs and prescription pain medication misuse among U.S. high school students-2019. BMC Public Health. 2024;24(1):1276.

31. Wallace GT, et al. Nonmedical prescription drug use among female adolescents: the relative influence of maternal factors, social norms, and perceptions of risk and availability. Drugs (Abingdon Engl). 2023;30(3):334–43.
32. Ford JA, McCabe SE, Schepis TS. Prescription drug misuse with Alcohol Coingestion among US adolescents: Youth experiences, Health-related factors, and other Substance Use behaviors. J Addict Med. 2023;17(4):379–86.
33. LaBossier NJ, Hadland SE. Stimulant misuse among youth. Curr Probl Pediatr Adolesc Health Care. 2022;52(9):101265.
34. Barbour WL, et al. Human immunodeficiency virus risk factors and beliefs reported by families presenting to a Pediatric Emergency Department. Pediatr Emerg Care. 2018;34(1):1–5.
35. Fix RL, et al. Factors promoting and impeding HIV testing among adolescents in juvenile drug court. AIDS Care. 2019;31(2):177–80.
36. Prevention C. f.D.C.a., *National YRBS Datasets and Documentation by Year.* 2024.
37. Mpofu JJ, et al. Overview and methods for the Youth Risk Behavior Surveillance System—United States, 2021. MMWR Supplements. 2023;72(1):1.
38. Aivadyan C, Slavin MN, Wu E. Inclusive state legislation and reduced risk of past-year suicide attempts among Lesbian, Gay, Bisexual, and questioning adolescents in the United States. Arch Suicide Res. 2023;27(1):63–79.
39. Lee JA, Lee S, Cho HJ. The relation between frequency of E-Cigarette use and frequency and intensity of cigarette smoking among South Korean adolescents. Int J Environ Res Public Health, 2017. 14(3).
40. Team RC. R: a language and environment for statistical computing. Vienna, Austria: Foundation for Statistical Computing; 2013.
41. Sharma A, et al. HIV and sexually transmitted Disease Testing Behavior among adolescent sexual minority males: analysis of Pooled Youth Risk Behavior Survey Data, 2005–2013. LGBT Health. 2017;4(2):130–40.
42. Liddon N et al. Annual STI Testing among sexually active adolescents. Pediatrics, 2022. 149(5).
43. Pampati S, Lowry R, Steiner RJ. Substance use, violence experiences, and mental health issues: are these health risks associated with HIV testing among sexually experienced US high school students? AIDS Care. 2019;31(9):1106–13.
44. Schumacher A, et al. Association between Marijuana Use and Condom Use: a Meta-analysis of between-subject event-based studies. J Stud Alcohol Drugs. 2018;79(3):361–9.
45. Bontempi JB, Mugno R, Bulmer SM, Danvers K, Vancour ML. Exploring gender differences in the relationship between HIV/STD testing and condom use among undergraduate college students. Am J Health Educ. 2009;40(2):97–105.
46. Thompson EL, et al. Correlates of STI Testing among US young adults: opportunities for Prevention. Prev Sci. 2021;22(2):216–26.
47. Fahey OB, et al. Black social media influencers engage higher percentages of black gay and bisexual men in online outreach for HIV prevention research relative to paid ads. Digit Health. 2024;10:20552076241253758.
48. *Fast Facts: HIV and Gay and Bisexual Men*. 2024.
49. Kaljee LM, et al. Sexual stigma, sexual behaviors, and abstinence among Vietnamese adolescents: implications for risk and protective behaviors for HIV, sexually transmitted infections, and unwanted pregnancy. J Assoc Nurses AIDS Care. 2007;18(2):48–59.
50. Douglas CM, et al. Racial and ethnic differences in Chlamydia and Gonorrhea testing locations among Medicaid-Insured Youth. J Adolesc Health. 2024;74(2):381–4.
51. Brooks RA, et al. Preventing HIV among latino and African American gay and bisexual men in a context of HIV-related stigma, discrimination, and homophobia: perspectives of providers. AIDS Patient Care STDS. 2005;19(11):737–44.
52. Yumori C, et al. Women are less likely to be tested for HIV or offered Preexposure Prophylaxis at the time of sexually transmitted infection diagnosis. Sex Transm Dis. 2021;48(1):32–6.
53. Hart L, et al. Impact of early stages of the COVID-19 pandemic on sexually transmitted infection screening claims among adolescent females in a Pediatric Accountable Care Organization in Ohio, United States. Cureus. 2022;14(11):e32070.
54. Kim YK, Small E, Okumu M. School-based HIV/AIDS education, risky sexual behaviors, and HIV testing among high school students in the United States. Soc Work Health Care. 2019;58(3):258–73.
55. Minguez M, et al. Reproductive health impact of a school health center. J Adolesc Health. 2015;56(3):338–44.
56. Moore MJ, et al. Support for Offering sexual health services through School-Based Health clinics. J Sch Health. 2016;86(9):660–8.
57. Aronson ID, et al. Automated substance Use/Sexual risk reporting and HIV Test Acceptance among Emergency Department patients aged 13–24 years. AIDS Behav. 2022;26(5):1544–51.
58. Pugatch DL, et al. HIV testing among young adults and older adolescents in the setting of acute substance abuse treatment. J Acquir Immune Defic Syndr. 2001;27(2):135–42.
59. Conley T, et al. Investigation of Consensually Nonmonogamous relationships. Perspect Psychol Sci. 2017;12(2):205–32.
60. Lehmiller JJ. A comparison of sexual Health History and practices among monogamous and consensually nonmonogamous sexual partners. J Sex Med. 2015;12(10):2022–8.
61. Levine EC, et al. Open relationships, Nonconsensual Nonmonogamy, and Monogamy among U.S. adults: findings from the 2012 National Survey of sexual health and behavior. Arch Sex Behav. 2018;47(5):1439–50.
62. Dellucci TV, et al. Correlates of HIV Testing across the lifespan - adolescence through later adulthood - among sexual minority men in the US who are not on PrEP. J Behav Med. 2022;45(6):975–82.