The difference in the association of risky sexual behaviors with substance use among US adolescents mediated by the type of substance.

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Abstract

Background

Although the relationship between risky sexual behaviors and substance use has been established, the interplay between different types of substances and risky sexual behaviors needs further exploration. We aimed to identify the prevalence of risky sexual behavior in US high school students and study the difference in the association of risky sexual behaviors with substance use mediated by the type of substances.

Method

We performed a retrospective cross-sectional study using Youth Risk Behavior Surveillance System (YRBSS) 2019 data that nationally represents US high school students in grades 9–12. We identified risky sexual behaviors as participants with four or more lifetime sexual partners who did not use a condom during intercourse.

Results

Out of 11,191 participants, 463 (3.9%) engaged in risky sexual behavior. 17- year old (37.1% vs. 23.0% ; $p < 0.0001$), $\geq$ 18-year old (26.0% vs. 12.8% ; $p < 0.0001$) and African American participants (16.8% vs. 10.3%; $p = 0.04$) had higher prevalence of risky sexual behavior. The prevalence of substance use among participants with risky sexual behavior was higher for all substances ($p < 0.0001$). In regression analysis, steroid use was associated with the highest odds of risky sexual behavior (aOR: 4.87, 95%CI: 2.48–9.57; $p < 0.0001$) followed by cocaine (3.80, 1.80–8.00; $p = 0.001$), marijuana (3.36, 1.64–6.89; $p < 0.0001$), alcohol (2.41, 1.05–5.55; $p = 0.039$), electronic vapor product (2.05, 1.004–4.19; $p = 0.049$), and traditional cigarettes (1.58, 1.10–2.28; $p = 0.016$).

Conclusion

Although the prevalence of risky sexual behaviors is low, the prevalence of substance use is significantly higher in participants with risky sexual behaviors. Among the different types of substances, anabolic steroid use has the highest odds of risky sexual behaviors. Clinicians should remain vigilant for anabolic steroid use when screening adolescents for substance use. Further research is needed to study the effects of anabolic steroids on health risk behaviors.

Introduction

According to the CDC, 1 in 5 people in the US have had a sexually transmitted disease (STD) and has an annual cost of nearly 16 billion dollars. ¹ STDs like chlamydia, gonorrhea, and syphilis combined

accounted for \$1.1 billion in direct medical expenses, and young people accounted for about 60% of those costs.¹ America's youth also shoulders a large portion of the annual burden of STIs. In 2018, 45.5% of all new STDs occurred among young people.¹ Growth in the rates of STDs and associated infection costs has created a sense of urgency in understanding the individual and situational factors that increase one's risk for disease. One such factor, substance use before sexual activity, has been shown to increase the likelihood of unsafe sexual intercourse.² Previous studies have shown that adolescents with substance use are more likely to become sexually active at an earlier age, have more sexual partners, and are more likely to have unprotected sex.³⁻⁵ According to the Surgeon General's report, substance use, including alcohol and other illicit drugs, is a growing problem in the United States.⁶ Thus, it is critical to identify if all substances or just specific substances are associated with risky sexual behaviors. The precise definition of risky sex or high-risk sexual behavior has varied throughout various studies in the past. Different studies have tried to explore different types of risky sexual behavior and study its association with various substances.⁷

One study found that increasing intensity of alcohol use is associated with an increased number of sexual partners; however, alcohol did not affect chances of unprotected intercourse.⁸ While the other study found that alcohol with co-ingestion of marijuana increases risky sexual behavior, marijuana use alone does not.⁹ Conflicting results regarding the effects of the same substance on risky sexual behavior may be due to confounding effects of other substances and the definition of risky sexual behavior used for that particular study.

We decided to use the latest YRBSS 2019 database to conduct our study. According to the CDC, "multiple sexual partners" in the YRBSS database are defined as participants with four or more lifetime sexual partners.¹⁰ For our study, we included risky sexual behaviors such as participants with multiple sexual partners, and they did not use a condom during the last intercourse. Using a computed variable that only includes participants with the presence of both risky sexual behaviors associated with the highest risk of STI and, to a lesser extent, unwanted pregnancy as our cohort, we aim to improve the clinical implications of our results.

Materials And Methods

Details of YRBSS data

The Youth Risk Behavior Surveillance System (YRBSS) contains statistics collected by the CDC to monitor health behaviors that contribute to the leading cause of morbidity and mortality among youth and adults. The six main categories monitored by YRBSS include 1) behaviors that contribute to unintentional injury and violence; 2) tobacco use; 3) alcohol and other drug use; 4) sexual behaviors that contribute to unintended pregnancy and STD/HIV infection; 5) dietary behaviors, and 6) physical inactivity. YRBSS also monitors the prevalence of asthma, obesity, and other health factors. YRBSS uses a 3-stage cluster sample design to produce a national representative sample of 9th to 12th-grade

students. A new YRBSS database is released every two years. The latest publicly available YRBSS database at the time of this study is the YRBSS 2019 database. The YRBSS data and documentation is available on the CDC website (<https://www.cdc.gov/healthyyouth/data/yrbs/data.htm>) as additional resources, including data documentation and analysis guides.

[<https://www.cdc.gov/healthyyouth/data/yrbs/index.htm>]

Study population

We performed a retrospective cross-sectional study using YRBSS 2019 data, excluding participants with missing information regarding age, sex, race, grade, and various substance use from the analysis.

Outcomes

The primary aim of this study is to evaluate the prevalence and characteristic patterns of risky sexual behaviors among US adolescents. The secondary objective of this study the difference in the association of risky sexual behaviors with substance use that may be mediated by the type of substance.

Risky sexual behavior

To identify risky sexual behavior, we used the following questions from the YRBSS 2019 database: "Q60. During your life, with how many people have you had sexual intercourse?". "Q63. The last time you had sexual intercourse, did you or your partner use a condom?". For this study, we defined *risky sexual behavior* as participants who met both the criteria of having four or more lifetime sexual partners and not using condoms during last intercourse. We believed that including only participants with both behaviors as risky sexual behavior would increase the generalizability of results. For this study, we decided to focus on sexual behaviors that increase sexually transmitted diseases.

Substance use

To identify substance use, we used the following questions from the YRBSS 2019 database: 1) Traditional cigarette- "Q30. Have you ever tried cigarette smoking, even one or two puffs?". 2) Electronic vapor product- "Q34. Have you ever used an electronic vapor product?". 3) Marijuana- "Q45. During your life, how many times have you used marijuana?". 4) Synthetic marijuana- "Q48. During your life, how many times have you used synthetic marijuana?". 5) Pain medication without prescription- "Q49. 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?". 6) Cocaine- "Q50. During your life, how many times have you used any form of cocaine, including powder, crack, or freebase?". 7) Inhalants- "Q51. During your life, how many times have you sniffed glue, breathed the contents of aerosol spray cans, or inhaled any paints or sprays to get high?". 8) Heroin- "Q52. During your life, how many times have you used heroin (also called smack, junk, or China White)?" 9) Methamphetamine- "Q53. During your life, how many times have you used methamphetamines (also called speed, crystal meth, crank, ice, or meth)?" 10) Ecstasy- "Q54. During your life, how many times have you used ecstasy (also called MDMA)?" 11) Anabolic steroids without prescription- "Q55. During your life, how many times have you taken steroid pills or shots without a doctor's prescription?". 12) Hallucinogens- "Q91. During your life, how many times have you

used hallucinogenic drugs, such as LSD, acid, PCP, angel dust, mescaline, or mushrooms?". 13) Injection drug use- "Q56. During your life, how many times have you used a needle to inject any illegal drug into your body?". 14) Alcohol- Since there was no direct question regarding alcohol use ever, we used the age of initiation of alcohol to find out participants who ever used alcohol. "Q40. How old were you when you had your first drink of alcohol other than a few sips?" Responses to all substance use questions were dichotomized as "yes" or "no."

Covariates and confounders

We included age, sex, race, grade, and concurrent substance use as potential covariates and confounders in our analysis.

Statistical analysis

We performed all the analysis using IBM SPSS, version 26. We used the complex sample add-on in SPSS to account for strata, clusters, and sample weight. We derived descriptive statistics using the Rao-Scott chi-square test for categorical variables to determine a statistically significant association. Strata, clusters, and weight accounted multivariable logistic regression analysis was used to determine the association between risky sexual behavior and substance use after adjusting for previously defined covariates and confounders. All statistical tests used were 2-sided. P-value < 0.05 was considered statistically significant. c-index (area under the ROC curve) to evaluate the goodness of fit was calculated for the regression model.

Results

Epidemiological characteristics of adolescents- YRBSS 2019 (Table 1)

Out of 11919 participants from YRBSS 2019, 463 (3.9%) engaged in risky sexual behavior. Among the age groups, 17-year old (37.1% vs. 23.0%; $p < 0.0001$) and ≥ 18 -year old (26.0% vs. 12.8%; $p < 0.0001$) participants had a higher prevalence of risky sexual behavior compared to participants who did not meet criteria for risky sexual behavior. The prevalence of risky sexual behavior was higher in African Americans (16.8% vs. 10.3%; $p = 0.04$). We also found a higher percentage of risky sexual behavior in participants in grade 11th (27.8% vs. 24.0%; $p < 0.0001$) and grade 12th (47.2% vs. 22.5%; $p < 0.0001$).

Table 1
Epidemiological characteristics of adolescents- YRBS 2019

Characteristics	Risky Sexual Behaviors [^]	No Risky Sexual Behaviors
N (%)	463 (3.9%)	11456 (96.1%)
Age n (%) **		
<= 14 year old	29 (6.3)	1431 (12.6)
15 year old	35 (7.6)	2943 (25.8)
16 year old	106 (23.1)	2945 (25.8)
17 year old	170 (37.1)	2621 (23.0)
>=18 year old	119 (26.0)	1458 (12.8)
Sex n (%)		
Female	219 (48.2)	5733 (50.4)
Male	236 (51.8)	5639 (49.6)
Race n (%) *		
Black or African American	76 (16.8)	1148 (10.3)
White	221 (48.9)	5847 (52.6)
Hispanic/Latino	36 (7.9)	1037 (9.3)
All other races	119 (26.3)	3094 (27.8)
Grade n (%) **		
9th	41 (8.9)	3129 (27.5)
10th	73 (15.9)	2947 (25.9)
11th	128 (27.8)	2733 (24.0)
12th	217 (47.2)	2565 (22.5)
<p>The % in the table above is column %, describing the comparison between risky sexual behavior and no risky sexual behavior. Frequency is weighted. *p < 0.05, **P < 0.0001.</p> <p>[^]Risky sexual behavior is defined as participants with four or more lifetime sexual partners who did not use condoms during last sexual intercourse.</p>		

Prevalence of risky sexual behaviors amongst adolescents with substance use (Table 2)

Prevalence of risky sexual behaviors was higher in participants who used alcohol (92.4% vs. 54.3%; p < 0.0001), traditional cigarettes (62.2% vs. 21.6%; p < 0.0001), electronic vapor product (90.3% vs. 48.0%; p

< 0.0001), marijuana (87.1% vs. 34.7%; $p < 0.0001$), synthetic marijuana (23.7% vs. 6.0%; $p < 0.0001$), pain medication without prescription (36.0% vs. 12.9%; $p < 0.0001$), cocaine (27.2% vs. 2.0%; $p < 0.0001$), inhalants (13.7% vs. 5.5%; $p < 0.0001$), heroin (8.7% vs. 0.6%; $p < 0.0001$), methamphetamine (12.6% vs. 0.9%; $p < 0.0001$), ecstasy (22.6% vs. 2.0%; $p < 0.0001$), anabolic steroids without prescription (11.5% vs. 1.1%; $p < 0.0001$), injection drugs (9.7% vs. 0.6%; $p < 0.0001$) and hallucinogens (30.5% vs. 5.5%; $p < 0.0001$).

Table 2
Prevalence of substance use among adolescents with risky sexual behavior.

Substance use	Risky sexual behavior	No Risky Sexual behavior
N(%)	463 (3.9%)	11456 (96.1%)
Alcohol n (%) **	418 (92.4)	6096 (54.3)
Traditional cigarette n (%) **	247 (62.2)	2163 (21.6)
E-cigarette n (%) **	407 (90.3)	5380 (48.0)
Marijuana n (%) **	360 (87.1)	3704 (34.7)
Synthetic marijuana n (%) **	100 (23.7)	640 (6.0)
Pain medication n (%) **	156 (36.0)	1408 (12.9)
Cocaine n (%) **	112 (27.2)	215 (2.0)
Inhalants n (%) **	55 (13.7)	552 (5.5)
Heroin n (%) **	37 (8.7)	67 (0.6)
Methamphetamine n (%) **	54 (12.6)	94 (0.9)
Ecstasy n (%) **	97 (22.6)	215 (2.0)
Steroids n (%) **	43 (11.5)	103 (1.1)
Injection drugs n (%) **	39 (9.7)	58 (0.6)
Hallucinogens n (%) **	113 (30.3)	499 (5.5)
The % in the table above is column %, describing comparison between risky sexual behavior and no risky sexual behavior. Frequency is weighted. * $p < 0.05$, ** $p < 0.0001$		

Multivariable survey logistic regression analysis (Table 3)

After adjusting for age, sex, race, grade and concurrent substance use, odds of risky sexual behavior were highest in participants who used anabolic steroids (aOR: 4.87, 95%CI: 2.48–9.57; $p < 0.0001$), followed by cocaine (3.80, 1.80–8.00; $p = 0.001$), marijuana (3.36, 1.64–6.89; $p < 0.0001$), alcohol (2.41, 1.05–5.55; $p = 0.039$), electronic vapor product (2.05, 1.004–4.19; $p = 0.049$), and traditional cigarettes (1.58, 1.10–2.28; $p = 0.016$). We did not find statistically significant results for the remaining substances. There was a

linear increase in odds of risky sexual behavior in participants aged 16 years (4.77, 1.56–14.62; $p = 0.008$), 17 years (6.57, 1.94–22.26; $p = 0.004$), and 18 years or older (7.36, 2.20–24.67; 0.002).

Table 3

Regression analysis establishing an association between substance use and risky sexual behaviors

Parameter	Adjusted Odds Ratio	95 % Confidence Interval
Model: Possibility of involving in risky sexual behaviour = 1		
Substance use		
Alcohol *	2.41	1.05–5.55
Traditional cigarette *	1.58	1.10–2.28
E-cigarette *	2.05	1.004–4.19
Marijuana *	3.36	1.64–6.89
Synthetic marijuana	0.84	0.51–1.37
Pain medication	1.15	0.81–1.63
Cocaine *	3.80	1.80-8.00
Inhalants	0.63	0.36–1.09
Heroin	1.42	0.68–2.98
Methamphetamine	1.22	0.41–3.59
Ecstasy	1.40	0.72–2.70
Steroids **	4.87	2.48–9.57
Hallucinogens	1.16	0.83–1.63
Age		
<=14 year	Reference	
15 year	1.23	0.46–3.26
16 year *	4.77	1.56–14.62
17 year *	6.57	1.94–22.26
>=18 year *	7.36	2.20-24.67
Sex		
Female	1.10	0.82–1.46
Male	Reference	
Race		
African American *	2.61	1.46–4.68
White	0.80	0.53–1.21

Parameter	Adjusted Odds Ratio	95 % Confidence Interval
Latino	0.72	0.40–1.29
Grade		
9th	Reference	
10th	1.02	0.38–2.75
11th	1.02	0.37–2.69
12th	1.47	0.42–5.09
c-value		872
*p < 0.05, **p < 0.0001. c-value (area under the ROC curve) provides the information regarding the goodness of fit for binary outcome in multiple logistic regression.		

Discussion

Our study found the prevalence of risky sexual behaviors to be 3.9%. The frequency of risky sexual behavior was higher in 17 years old and 18-year-old or older participants than participants who did not meet the criteria for risky sexual behavior. Participants with risky sexual behavior reported a higher frequency of usage of all substances included in our study.

We found several interesting relationships between substance use and risky sexual behavior. We discovered that non-prescription steroid use was associated with the highest odds of risky sexual behavior among all substances, previously defined as having four or more lifetime sexual partners, and those who did not use a condom during their last intercourse. Cocaine use had the second-highest odds, while alcohol and e-cigarette use had the third and fourth highest odds of risky sexual behavior. After adjusting for demographics and other substances, we did not find a statistically significant association between synthetic marijuana, pain medications without prescription, inhalants, heroin, methamphetamine, ecstasy, hallucinogens, and odds of risky sexual behavior.

Our results support the established link between risky sexual behavior and substance use. Our analysis also provides novel findings that further our understanding of the association between risky sexual behavior. For example, in our combined model that included all substances, steroid use was associated with the highest odds of risky sexual behavior. Secondly, because we only included participants with both risky sexual behavior as our cohort, our results suggest that steroid use is associated with the highest odds of having four or more lifetime sexual partners and not using condoms during last intercourse. Since the presence of both risky factors can exponentially increase the odds of STI and unwanted pregnancy to a lesser extent, our results have better utility in designing policies to prevent the use of substances associated with higher odds of both behaviors.

Concerning why steroid use confers increased risky sexual behavior, different potential pathways are studied. Anabolic steroid use is associated with increased impulsivity, verbal aggression, and sexual arousal.¹¹ Steroid use may induce a hypomanic episode associated with increased pleasure-seeking risk-taking, potentially leading to risky sexual behavior.¹² Although these effects are associated with steroid use, the intensity of these effects varies individually, some having profound psychological effects from steroid use while others have little change from their baseline.¹³ It is also possible that we may only observe these effects during the acute phase of steroid use. However, chronic users may not have the same effects.¹⁴ In addition, anabolic steroid users are more likely to use drugs such as marijuana, prescription opioids, cocaine, or heroin.^{15,16} Anabolic steroid users may use opioids to counteract insomnia, irritability, depression, and withdrawal from anabolic steroids.¹⁷ Steroid use is also associated with increased odds of using alcohol and other illicit drugs during sex.¹⁸ Therefore, using anabolic steroids seems to be a gateway to other forms of risky behavior, not just the type of risky sexual behavior we defined in our study. The other top substances which we found to be associated with risky behavior in this study may have causal paths that could explain the association between illicit drug use and risky sexual behavior. For example, alcohol intoxication can reduce the drinker's perception of potential risks of engaging in risky sexual behavior.¹⁹ Cocaine use can increase sexual desire and the probability of engaging in unprotected sex in a dose-dependent manner, primarily when the STI status of the opposite person is not known.²⁰ Each substance may have its unique effects on the odds of engaging in risky sexual behavior. It is also possible that engaging in risky sexual behavior may be associated with subsequent drug use.²¹ These youth populations may find themselves alienated from unwanted pregnancy and subsequently attached to other deviant peers facilitating exposure to illicit substances.²² Other psychosocial factors such as having friends who engage in risky sexual behavior can increase the odds of engaging in risky sexual behavior in the presence of heavy substance use.²³

Limitations

CDC conducts the YRBSS survey by utilizing high school students. Thus, we could not study the prevalence of substance use in students who do not attend high school. Secondly, not all states and school districts included all the standard questions on their YRBS questions resulting in missing values for specific variables. Our study results are based on a cross-sectional design. Thus, we were not able to establish a temporal relationship between risky sexual behavior and substance use.

Conclusion

Although the prevalence of risky sexual behavior is low in US high school students, the prevalence of substance use is significantly higher in participants who engaged in risky sexual behavior. Among the different types of substances, anabolic steroid use has the highest odds of risky sexual behavior, followed by cocaine, marijuana, alcohol, e-cigarettes, and traditional cigarettes. Clinicians should remain vigilant for anabolic steroid use when screening adolescents for substance use. We encourage further research exploring anabolic steroid use and its effect on health risk behaviors.

Declarations

Grant Support/Funding: The study had no internal or external funding source.

Disclosure of potential conflict of interest:

The authors declare no conflict of interest.

Ethical approval:

Though this article does not contain any studies with direct involvement of human participants or animals performed by any of the authors, all procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards.

Informed Consent:

The data used in this study is deidentified FROM YRBSS- CDC UNDER DUA. Thus informed consent or IRB approval was not needed for this study.

Availability of data and material: The data is publicly available, and specific details related to data and/or analysis will be made available upon request.

Authors' contributions:

Conceptualization: Saral Desai; Methodology: Saral Desai; Acquisition of data: Saral Desai; Formal analysis and investigation: Saral Desai; Writing - original draft preparation: Saral Desai, Nishat Kulkarni; Writing - review, critical feedback, and editing: Sanila Rehmatullah; Funding acquisition: None; Resources: None; Supervision: Sanila Rehmatullah.

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