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Investigating the Association between Adolescent Polysubstance Use, Crime, and Violence in the United States

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by

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ABSTRACT

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The lifetime prevalence of alcohol in the U.S is 8% and that of illicit drug use is about 2-3%. About 20% of teens have suffered physical or sexual violence from dating partners, 16% of arrests involve adolescents, and injuries are the leading cause of death among adolescents. We examined the prevalence of substance use, dating violence, adolescent criminal arrests and weapon-related injuries and the association between polysubstance use and each of them.

The prevalence of adolescent physical, sexual and combined physical and sexual dating violence was 8.2%, 8.2% and 2.6% respectively. Compared to single substances use, adolescents who used polysubstance were 2.1 times, 2.1 times and 2.8 times, more likely to experience physical (OR = 2.10, 95% CI = 1.27 – 3.47) sexual (OR = 2.11, 95% CI = 1.34 – 3.34) and combined physical and sexual (OR = 2.75, 95% CI = 1.34 – 5.61) dating violence, respectively.

Prevalence of adolescent criminal arrests was 17.2%. Adolescents who combined select illicit drugs with alcohol were 1.7 times more likely to be arrested. Adolescents

who used select illicit drugs with marijuana were 1.5 times more likely to be arrested, while adolescents who used all three substances were 1.6 times more likely to be arrested compared to those who used select illicit drugs only.

The prevalence of weapon-related injuries was 7.4% and adolescents who used tobacco and marijuana had 2.7 the odds of injuries while adolescents who used alcohol and marijuana were 60% less likely to experience injuries. Adolescents who used no substances were 50% less likely to sustain injuries while adolescents who used polysubstance had 1.8 the odds of injuries compared to single substance users.

This study shows that the odds of dating violence, criminal arrests and weapon-related injuries are higher with polysubstance use compared to no or mono-substance use. Adolescents who did not use substances had lower odds of dating violence and weapon-related injuries compared to single substance users. Preventing substance use initiation is beneficial, and gradual scaling down of polysubstance use can be utilized in the planning and implementation of preventive efforts aimed at decreasing the impacts of polysubstance use on adolescent health.

DEDICATION

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LIST OF ACRONYMS

ADHD – Attention Deficit Hyperactivity Disorder

CDC – Center for Disease Control and Prevention

CI – Confidence Interval

CSA – Controlled Substance Act

DV – Dating Violence

FBI – Federal Bureau of Intelligence

GED – General Educational Development

IQ – Intelligence Quotients

NC – North Carolina

OECD – 0rganization for Economic Cooperation and Development

OR – Odds Ratio

SAMHSA – Substance Abuse and Mental Health Services Administration

SAS – Statistical Analysis System

TEDS- A – Treatment Episode Data Set – Admission

TDV – Teen Dating Violence

U.S – United States

USA – United States of America

WHO – World Health Organization

WRI – Weapon Related Injury

YRBSS – Youth Risk Behavior Surveillance System

Chapter 1. Introduction

Substance use among adolescents has been associated with accidental injuries particularly automobile accidents, physical and sexual violence, poisoning and drug overdoses, sexually transmitted diseases, and respiratory and cardiac health problems (Schulte & Hser, 2014). There are also many associated psychiatric health issues including depression, anxiety, oppositional defiant disorders, attention deficit hyperactivity disorder (ADHD) and conduct disorders (Schulte & Hser, 2014). According to the Center for Disease Control and Prevention (CDC), the earlier adolescents begin using substances, the more likely they are to continue the use of substances and to develop substance use problems later in life. Substance use can affect the growth and development of teens and this is particularly true as it relates to adolescent brain development (Winters & Arria, 2011). Substance use also occurs more frequently with other health risk behaviors including dangerous driving and unprotected sexual intercourse and may contribute to health problems in adulthood including heart disease, and sleep disorders (Odgers et al., 2008, Schulte & Hser, 2014). Because the adolescence period is associated with significant developmental changes, even moderate use of substances can cause significant harm (Guerri & Pascual, 2010, Volkow et al., 2014).

Substance use is the use of psychoactive substances while substance abuse refers to harmful use of substances including alcohol and illicit drugs (WHO, 2018). This is different than addiction, which is a chronic, relapsing disorder characterized by compulsive drug seeking and use despite adverse consequences. Addiction to substances is considered a brain disorder which involves functional changes in the

brain circuits related to reward, stress, and self-control (American Psychiatric Association, 2017). Substance use does not include compulsive drug seeking which is an important component of addiction.

The use of one substance does not preclude indulgence in other substances. In fact, studies have shown that youths who use one substance are likely to use other substances as well (Odgers et al., 2008, Sampasa-Kanyinga, 2018). Marijuana, tobacco, and alcohol consumption are the most used substances among adolescents (Sampasa-Kanyinga, 2018). Other studies also support the finding that alcohol, marijuana, and tobacco are the substances most used by adolescents (Johnson et al., 2014). About 67% of 12th grade students have tried alcohol (Johnson et al., 2014), 50% of students from 9th through 12th grades reported having used marijuana (PartnershipTM, 2013), and 40% of students from 9th through 12th grades have tried tobacco (Kahn et al., 2014). Data from the Youth Risk Behavior Surveillance System also shows that “select illicit drugs” had a prevalence of 15% among the study participants. “Select illicit drugs” includes cocaine, inhalants, heroin, methamphetamine, hallucinogens, and ecstasy/other amphetamines. The use of two or more substances within a period or use of two or more substances at once is referred to as polysubstance use (American Addiction Centers, 2020). Trenz al (2012) defined polysubstance use as the use of any two or all three substances used in the research (alcohol, cigarettes, marijuana) at or before age 15. The time frame of “at or before 15 years” was customized for the study. In our studies, we will be referring to polysubstance use as the use of multiple substances (the use three or more of tobacco, select illicit drugs, alcohol, and marijuana) within a 30day period.

Polysubstance use is often understood to mean the use of multiple illicit drugs but, it also includes prescription medications used in nonmedical circumstances (American Addiction Centers, 2020). Considering that alcohol, tobacco, select illicit drugs and marijuana are the most used substances among adolescents, polysubstance use in our study is the combination of any three or more of alcohol, tobacco, select illicit drugs, and marijuana.

Another important public health issue in adolescence is dating violence and it is linked to numerous, serious, and long-lasting health and economic consequences (Temple & Freeman, 2011). Adolescents who have experienced dating violence report adverse health outcomes later in life. Females who experienced dating violence are more likely to be involved in heavy episodic drinking, symptoms of depression, suicidal tendencies, and smoking (Exner-Cortens et al., 2013). In recent research, 20.9% of adolescent females and 10.4% of adolescent males who dated, experienced some form of dating violence with females having higher prevalence of all forms of dating violence including physical, sexual and a combination of both physical and sexual violence (Vagi et al., 2015). In another study among middle school youths in high-risk urban communities, more than 70% of students who dated perpetrated verbal or emotional abuse, more than 30% perpetrated physical abuse, 13% perpetrated sexual abuse and about 20% of the participants threatened their partners (Niolon et al., 2015). Studies have found that adolescent youths who experienced dating violence have higher likelihoods of smoking cigarettes, drinking alcohol, and using marijuana when compared to their counterparts who did not experience any form of dating violence (Temple & Freeman, 2011).

Over the past few years, the rate of arrests and incarceration has increased dramatically. For example, between 1980 and 2011, the rate of incarceration rose by 397% (Carson & Sabol, 2012) and is not showing any evidence of decline. On average, the annual rate of arrests over the past 30 years is about 10 million people, and in 2019 alone the Federal Bureau of Investigation reported that about 10.1 million arrests were made nationwide excluding traffic-related offences (Federal Bureau of Intelligence**,** 2020). About 1.5 million of these arrests were for alcohol-related offences while 1.6 million were related to drug abuse violations offences. About 16% of the arrests were people under the age of 21 years (Federal Bureau of Intelligence**,** 2020). According to Glaze (2012) about 7 million people were in the criminal justice system with more than half the number on probation or parole. There have been suggestions that if the population of incarcerated persons were likened to a city, that city will be the second largest in the United States (Drucker, 2011).

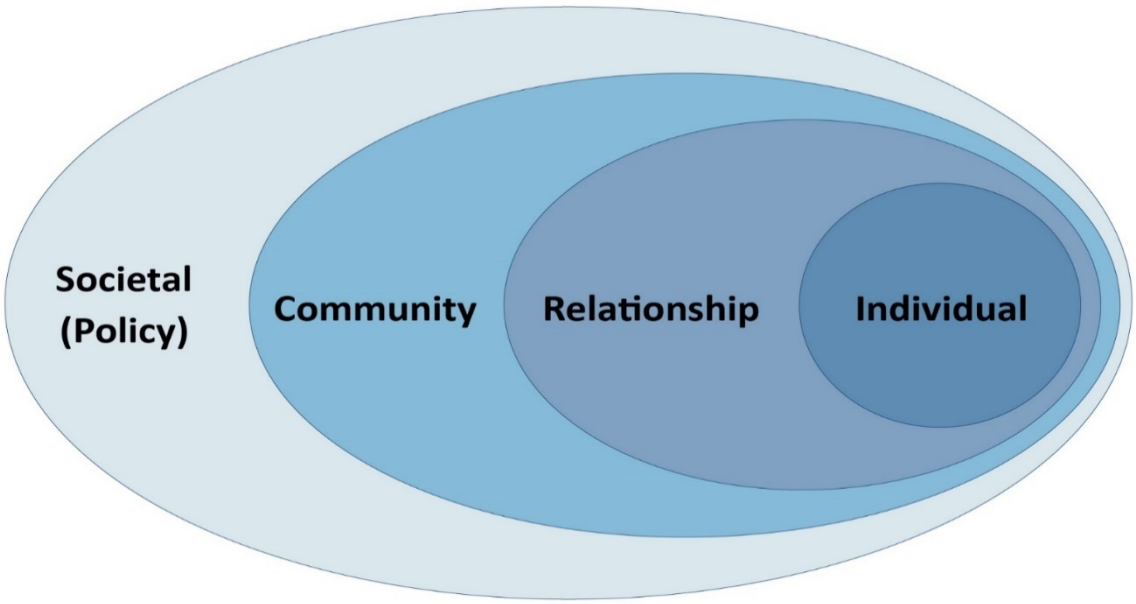
Weapon-related injuries are also of public health importance due to its contribution to childhood disabilities and deaths (Fowler et al., 2017). Among children under the age of 18 years, injuries are among the leading causes of death (Orton et al., 2016). Access to firearms is a potential risk for weapon-related injuries both among substance using and substance non-using adolescents. In the U.S, about 4.6 million minors live in homes with at least one loaded, unlocked firearm (Azrael et al., 2018). There is evidence that when guns are absent in homes and communities, firearm-related injuries can be reliably and effectively prevented (Dowd, 2012).

An Encompassing Model for the Research

Factors that contribute to substance use can be better understood using the socio-ecologic model as shown in figure 1. Since it is not possible to fully understand adolescent development and behavior without considering the elements within and without the individual that interact to contribute to the behavior, the socio-ecological framework reminds us that our individual and group behaviors as well as health outcomes are influenced by elements ranging from our genes to the policies and political environment, we live in. The model is applicable not only to substance use behavior, but also to adolescent dating violence, involvement in criminal activities resulting to arrests, and weapon-related injuries.

Figure 1.

The Socio-Ecological Model: A Framework for Prevention (Adapted from the Center for Disease Control and Prevention, 2021)



The model indicates that there are several factors that influence an individual's behaviors and health outcomes. At the individual level factors biological/genetic factors (e.g., age, sex, genetic diseases), alcohol and drug use, individual's personal history, attitudes and beliefs that support substance use, dating violence, use of weapons, infliction of injuries, and criminal activities. For example, a personal history of experiencing violence may influence an adolescent's attitudes about perpetrating violence. Age, a biological factor, may also influence the adolescent's risk-taking behaviors in terms of substance use, weapon use and weapon-related injuries, as well as involvement in criminal activities that may result in arrests. Attitudes and beliefs also play important roles. According to the Centers for Disease Control and Prevention, (CDC - Understanding Teen Violence, 2014), factors that increase the risk for harming a dating partner include personal issues such as belief that dating violence is acceptable, early sexual activity and having multiple sexual partners, depression, anxiety, aggressive behaviors toward peers. Also, substance use is an important risk factor for dating violence among adolescents.

At the interpersonal level are factors such as relationships with family members, intimate partners, and peers which can influence the tendency for substance use, dating violence, criminal arrests, and weapon-related injuries. In a bid to maintain relationships with peers, adolescents do get involved in the group cultures and activities and these may include cultures such as substance use, engagement in illegal/criminal activities, and weapon carrying. Intimate partners may influence adolescents' behaviors. For instance, if an adolescent uses substances, or is involved in criminal activities their partners are likely to be influenced to do same. Adolescents who date violent partners

are likely to experience dating violence and weapon-related injuries. According to the CDC (Understanding Teen Violence, 2014), conflicts with partner, having friends involved in dating violence, and witnessing or experiencing violence in the home are important interpersonal factors that are associated with dating violence. Also, adolescents who have been abused by care givers or have been in abusive relationships with intimate partners are likely to exhibit violent behaviors, get involved with crime, and engage in substance use.

At a broader level of interaction are the factors within the community and social environment that moderate an individual's behaviors. This includes an adolescent's relationship with the workplace, school, church, or neighborhood. It also includes the mass media, social media, and social services. One example is the effect of workplace social support on the behavior of the adolescents. If the adolescent works in an environment where he is not judged, bullied, or shamed, and there is adequate support and motivation not to indulge in substance use, crime, and violence, such a person is less likely to indulge. The moral lessons learnt in churches may also play a role in the individual's behavior thereby affecting their tendencies for substance use, dating violence, criminal arrests, weapon use, and weapon-related injuries. Social media and mass media platforms that promote substance use, violence and weapon use may be important influence in adoption of such behaviors by adolescents. Social and mass media advertising of alcohol and cigarettes is a handy example. Neighborhoods may also influence behaviors such as criminal activities, dating and weapon-related violence. Such environments are usually rife with substance use because crime and substance use have important positive relationship. Some studies indicate that early onset of

substance use was associated with criminal involvement, bullying and cruelty to people (Gordon et al., 2004).

There are also larger societal factors that influence behaviors and public health outcomes. Gender inequality, societal norms that characterize women as the weaker sex, and religious beliefs may play roles in dating violence. Societal issues like racism and stereotyping individuals from certain population groups as being prone to criminal activities, may lead to higher tendencies to arrest adolescents from that population group. Alexander (2010), had found a disproportionately heavier burden of arrests and incarcerations among people of color when compared to Whites, illustrating how racism and stereotyping can contribute to inequalities in criminal arrests. The Controlled Substance Act (CSA) which waged wars against the use of certain substances about 50 years ago is an example. The policy contributed to escalations in drug-related criminal arrests (Alexander, 2014), and showcases how policies affect public health. In the case of firearm/weapon-related injuries, it was only about two years ago that the government commenced funding for gun injuries prevention research following more than two decades of failure to allocate funds for research into gun-related injuries prevention. Such policies which did not consider gun-related injuries funding as a priority may have robbed public health researchers the opportunity to develop strategies for firearm injuries prevention for many years. This further illustrates how public policy at the macro level can influence health at the individual level.

The socio-ecologic framework is therefore a vital model that encompasses factors which relate to substance use, dating violence, adolescent criminal arrests, and weapon-related injuries. Though the factors that influence each of the above variables

may differ slightly, in general, all of them are encompassed by the components of the socio-ecologic model cutting across individual factors, interpersonal relationships, community and societal factors. Our research addresses the individual and relationship levels of the socio-ecologic model as it pertains to polysubstance use, dating violence, adolescent criminal arrests, and weapon-related injuries.

Significance of the Research

Research Gaps on the Influence of Polysubstance Use on Dating Violence, Criminal Arrests and, Weapon-related Injuries among Adolescents

While there has been much research about the relationship of single substances with health outcomes, there is a paucity of research on the relationship between polysubstance use and different health outcomes including dating violence, weapon-related injuries, and social issues such as adolescents' criminal arrests. According to the American Addiction Centers (2020), polysubstance use often refers to use of multiple illicit drugs, but also includes use of multiple prescription medications in non-medical circumstances. Many people intentionally engage in polysubstance use in attempts to increase the experienced effects of multiple substances (American Addiction Centers, 2020). This may begin as unintentionally mixing two or more drugs, for example a person using prescription opioids may also take a glass of alcohol at about the same time. Eventually, the individual intentionally uses polysubstance to achieve the desired high (American Addiction Centers, 2020)

The effects of combining substances could be detrimental to health in several ways. All drugs/illicit substances have the potential for negative side effects and when

used together in varying combinations, the potential for these side effects is increased (American Addiction Centers, 2020). These effects could be either additive or synergistic in nature and does not always represent the sum of the effects of the substance. There is also the danger of overdose when substances are combined because certain substances mask the effects of others and users may take higher doses than usual to feel the same effects as previously. Some substances may reinforce the effects of others. Overdose may then lead to death.

When people combine multiple substances, the treatment for each of those substances becomes more complicated and difficult. For example, treatment of acute opioid intoxication may be complicated by alcohol use, just as a chronic combination of alcohol and marijuana use is more complicated and difficult to treat than each of the two individually. The complications of polysubstance use are worsened by co-occurring mental health issues because when a mental health disorder is present in the setting of substance use, such individuals are more likely to engage in polysubstance use. Polysubstance use on the other hand, worsens mental health disorders (National Alliance on Mental Illness, 2020).

Acute health problems have also been noticed with polysubstance use. Substances do interact with each other and this could affect their metabolism in certain cases. Reduced metabolism of substances could lead to increased blood concentrations of such substances which then prolongs or increases their side effects (European Monitoring Center for Drugs and Drug Addiction, 2009). In other instances, interaction of two or more substances could lead to metabolism of one or more of the substances to more potent metabolites.

Adolescents who have experienced dating violence report substance use and adverse health outcomes later in life. The manifestations of dating violence seem to vary between the sexes. Females who experienced dating violence are more likely to be involved in heavy episodic drinking, suicidal tendencies, and smoking (Exner-Cortens et al., 2013). They are also more likely to develop symptoms of depression. Males have increased antisocial tendencies, and marijuana use (Exner-Cortens et al., 2013).

There is an association between substance use among high school students and adverse academic and health outcomes. There is also an association between substance use and significant risks to personal safety (Arria, 2017). Self-reported alcohol-related injuries were more likely to occur among those aged younger than 25 years (Coomber et al., 2017). Drug use was associated with having sustained two or more injuries in the past 12 months (Peltzer, 2017) and the association appears to be similar for both sexes.

With these potential health effects of polysubstance use, it is important to investigate how polysubstance use relates to dating violence, adolescent criminal arrests, and weapon-related injuries. There are studies that have examined the relationships between each of alcohol use, select illicit drugs, marijuana use, and tobacco use and each of dating violence, adolescent criminal arrests, and weapon-related injuries. There is however paucity of research on the association between polysubstance use and each of dating violence, adolescent criminal arrests, and weapon-related injuries. So far, only a few articles have examined the association between polysubstance use and dating violence. For instance, one study examined the

relationship between polydrug use and dating violence among emerging adults in a group of ethnically diverse population in Texas (Choi et al., 2020), but the study only examined alcohol and marijuana use. Also, the research was among emerging adults rather than school-going adolescents. There is also paucity of research on the association between polysubstance use and either of criminal arrests or weapon-related injuries among adolescents.

The gap in knowledge stated above informs how pertinent the contributions from the proposed study are to existing literature that addresses the relationships between polysubstance use and health outcomes among adolescents. This study aims to understand the association between polysubstance use and dating violence among adolescents, to explore how polysubstance use is related to adolescent criminal arrests and, to seek the relationship between polysubstance use and weapon-related injuries among school-going adolescents in the United States. The specific aims of this study are further described below.

Specific Aims

1. Investigating the association between polysubstance use and dating violence among adolescents.

   1a. Understanding the prevalence of dating violence among adolescents.

   1b. Exploring the relationship between polysubstance use and dating violence among adolescents.
2. Exploring the association between polysubstance use and criminal arrests among adolescents.

   2a. Understanding the prevalence of criminal arrests among adolescents.

2b. Exploring the association between polysubstance use and criminal arrests among adolescents.

3. Exploring the association between polysubstance use and weapon-related injuries among adolescents.

   3.a To determine the prevalence of weapon-related injuries among high school students.

   3b. Understanding how each of alcohol, tobacco, marijuana, and select illicit drugs is related to weapon-related injuries among school-going adolescents.

   3c. To examine the association between polysubstance use and weapon-related injuries among school-going adolescents.

Hypothesis of the Study

The hypothesis of the study is that polysubstance use is associated with increased odds of dating violence, criminal arrests and, weapon-related injuries among adolescents compared with no substance and single substance use. There is likely a dose-response relationship between the number of different substances used and the odds of dating violence, criminal arrests and, weapon-related injuries in this population group.

Literature Review

According to the Centers for Disease Control and Prevention (CDC, Sampasa-Kanyinga, 2018), alcohol, tobacco, marijuana, and heroin are the most used substances among adolescents. Findings from a nationally representative sample of United States

adolescents shows that lifetime prevalence of alcohol was 8% and lifetime prevalence of illicit drug use was 2-3% (Merikangas et al., 2010, Swendsen et al., 2012).

Alcohol exposure during adolescence may adversely affect brain development and maturation by causing structural alterations and cognitive deficits. This damage is more likely in adolescents because the brain is in rapid development and maturation such that even moderate use of alcohol can cause significant harm (Guerri & Pascual, 2010). Other substances such as marijuana use also present health concerns among adolescents and just like in alcohol use, regular or heavy marijuana use has significant effects on the developing adolescent brain (Volkow et al., 2014). Because marijuana use typically begins in adolescence, it corresponds to a period in the developing brain when cannabinoid receptors (receptors for marijuana products) in the white brain matter are in abundance. This relationship may explain why the adolescent brain is more vulnerable to the effects of marijuana use (Zalesky et al., 2012). Possible consequences of the effects of marijuana use on the brain, are the associated poor educational outcomes in individuals who were exposed to early use of marijuana (Fergusson et al., 2015), and the higher rates of school drops outs. Some studies have also found a relationship between regular or heavy exposure of the developing adolescent brain to marijuana and cognitive impairment, lower intelligence quotients (IQ), and lower life satisfaction and achievement among this group (Fergusson & Boden, 2008).

The relationship between substance use and many health outcomes have been studied but studies showing the relationships between polysubstance use and adolescent dating violence, criminal arrests and weapon-related injuries are few. One study examined the sociodemographic and psychosocial risk factors that moderate

polysubstance use and dating violence victimization and perpetration relationship among emerging adults. They found that participants who used polysubstance were the most likely to perpetrate dating violence (Choi et al., 2020).

Adolescents who had experienced physical and psychological teen dating violence were more likely to be polysubstance users compared with adolescents that are non-victimized (Parker & Bradshaw, 2015). Findings indicate that dating violence affects a substantial number of youths even when only physical dating violence is considered, and many youths involved in dating violence may be perpetrators, victims, or both (Haynie et al., 2013). The above study found that the prevalence of dating violence victimization was 35% and that of perpetration was 31%.

Also, adolescent students with recent alcohol or marijuana use were at increased odds of experiencing physical dating victimization compared to students who reported little or no alcohol or marijuana use (Parker et al., 2016). Physical dating violence perpetration increased at time-points when heavy alcohol and hard drug use were elevated (Reyes et al., 2015). The association between heavy alcohol use and physical dating violence perpetration was weaker when teens had more prosocial peer networks and stronger when teens' peers reported more physical dating violence (Reyes et al., 2015). A recent study explored reasons for dating violence and, the relationship between daily substance use and dating violence among high school students. It found that alcohol use was associated with various types of dating violence including physical and sexual dating violence (Parker et al., 2015)

In a study that examined whether substance use (alcohol, marijuana and "hard drugs") predicts the perpetration of physical teen dating violence across time,

researchers found that the use of alcohol and hard drugs at baseline predicted the future perpetration of physical dating violence after controlling for other factors (Temple et al., 2013). Longitudinal associations did not vary by gender. Among Caucasian adolescents, exposure to mother-father violence predicted the perpetration of dating violence (Temple et al., 2013).

Although substance use is associated with an increased risk of arrest (Sittner et al., 2015) not much research has been done on the association between polysubstance use and criminal arrests. A study investigating the prevalence and patterns of polysubstance use in a nationally representative sample of 10th graders in the U.S, showed that among those arrested for criminal activities, past-year use of marijuana was the most common among illicit drugs (26%), followed by misuse of medication (9%) and use of other illicit drugs (8%). During the past month, alcohol use was reported by more than one-third (35%), binge drinking by 27%, and cigarette smoking by 19% (Conway et al., 2013). Regarding race, Black youths reported less polysubstance use and later age of drug use onset than White and Latino youth. Latino juvenile offenders and those with an early and problematic pattern of substance use, were more likely to be polysubstance users (Racz et al., 2016).

There is also an association between substance use and significant risks to personal safety (Arria, 2017). Self-reported alcohol-related injuries were more likely to occur among those aged younger than 25 years (Coomber et al., 2017). Drug use was associated with having sustained two or more injuries in the past 12 months (Peltzer, 2017) and the association appears to be similar for both sexes.

The relationship between polysubstance use and weapon-related injuries has not been well documented in the literatures. Despite paucity of literature on the relationship between polysubstance use and weapon-related injuries, we understand the growing concern about the increasing incidence of weapon-related injuries in schools in the United States because injuries are the leading cause of death among children aged 4 to 18 years (Orton et al., 2016). Because unintentional injuries represent one of four major causes of death among individuals aged 10-24 years (Eaton et al., 2008), and unintentional injuries are on the rise (Hemenway et al., 2011, Ozkan, 2016), there is need to explore how polysubstance use contributes to injuries in the adolescent age group.

Chapter 2. Exploring the Relationship between Polysubstance Use and Dating Violence among School-going Adolescents in the United States

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Abstract

Objective: Dating violence is an important public health problem and about 20% of adolescents have experienced either physical or sexual dating violence. Substance use is also of public health concern and the relationship between polysubstance use and adolescent dating violence is not fully understood. This study aims to assess how polysubstance use affects the odds of dating violence among adolescents.

Methods: Our study population (N = 13,677, ages 13 -19 years) of adolescents were monitored for six categories of priority health-risk behaviors including substance use and violence**.** Using single substance use as the reference, we examined the odds of dating violence among adolescents who did not use substance, and those who used polysubstance relative to those who used only single substance. Multiple logistic regression was used to examine the association between polysubstance use and dating violence after adjusting for covariates.

Results: Males were 30% (OR = 0.69, 95% CI = 0.57 – 0.94) and 70% (OR = 0.28, 95% CI = 0.21 – 0.38) less likely to experience physical dating and sexual dating violence, respectively. Adolescents who did not use any substance were 50% less likely (OR = 0.49, 95% CI = 0.27 – 0.89) to experience physical dating violence and 40% less likely (OR = 0.56, 95% CI = 0.38 – 0.83) to experience sexual dating violence compared to those who used single substance.

Adolescents who used polysubstance were 2.1 times (OR = 2.10, 95% CI = 1.27 – 3.47) more likely to experience physical dating violence, 2.1 times (OR = 2.11, 95% CI = 1.34 – 3.34) more likely to experience sexual dating violence and 2.8 times (OR = 2.75, 95% CI = 1.34 – 5.61) more likely to experience both physical and sexual dating violence compared to those who used only a single substance.

Conclusion: Adolescents who did not use substance were less likely to experience dating violence while those who used polysubstance were more likely to experience dating violence compared to those who used single substances. Interventions aimed at substance use should target prevention of substance use initiation as well as gradual reduction of substances used, one substance per time.

Keywords: dating violence, sexual dating violence, physical dating violence, polysubstance use

2.1. Introduction

Dating violence among adolescents is of public health concern and its prevention and reduction is an issue deserving national urgency (Offenhauer & Buchalter, 2011)

About 20% of adolescents have been physically or sexually abused by their partners during dates (Silverman et al., 2001), with African Americans representing the highest proportion of racial groups who had either perpetrated or been victims of dating violence (Centers for Disease Control and Prevention, CDC, 2006). Dating violence may either be sexual dating violence or physical dating violence both of which constitute important personal and public health concerns.

The relationship between dating violence and substance use has been documented in literature but there remains a paucity of data on the relationship between polysubstance use and adolescent dating violence. One study examined the sociodemographic and psychosocial risk factors that moderate the polysubstance use and dating violence victimization and perpetration relationship among emerging adults (Choi et al., 2020). They found that participants who used polysubstance were the most likely to perpetrate dating violence. This likelihood to perpetrate dating violence is higher in participants who drank heavy alcohol and used marijuana; much lower among those who occasionally used alcohol and marijuana; and lowest among regular alcohol and mild marijuana users. The study concluded that there is the need to comprehensively address dating violence among emerging adults; directing prevention and intervention programs to emerging adults who misuse substance and are exposed to dating violence.

In another study (Parker & Bradshaw, 2015), five classes of substance users were identified: two polysubstance using (moderate and high) classes, one alcohol using class, one alcohol and marijuana using class, and one no-use class. In this study, adolescents who had experienced physical and psychological teen dating violence were more likely to be in the two polysubstance use classes (i.e., moderate, and high) and alcohol & marijuana use class compared with adolescents that are non-victimized. They concluded that preventive interventions should target high risk groups e.g., polysubstance using students or varied patterns of substance use. Substance use preventive interventions should address teen dating violence (TDV) because of the association between TDV victimization and increased risk of substance use. For example, adolescent students who reported frequent recent alcohol or recent marijuana use were at increased odds of experiencing physical dating victimization compared to students who reported little or no alcohol or marijuana use (Parker et al., 2016). Therefore, prevention efforts to address alcohol and marijuana use may influence TDV victimization.

The relationship between polysubstance use and adolescent dating violence is not fully understood. It is unknown if the use of multiple substances (polysubstance use) results in increased odds of dating violence when compared to the use of single substances or even non-use of substances. Our study therefore aims to understand the prevalence of dating violence among adolescents and to explore the relationship to determine how the use of polysubstance influences the odds of adolescent dating violence in our population group, a representative sample of the United States adolescent population.

2.2. Methods

2.2.1. Study Population

The data were obtained from the 2019 Youth Risk Behavior Surveillance System (YRBSS) (n= 13,677, age = 13-19 years), which monitors six categories of priority health-risk behaviors among youths and young adults. These include behaviors that contribute to unintentional injuries, tobacco use, and alcohol and drugs use. The sampling frame for the 2019 national YRBSS consisted of all regular public and private schools with students within the class range of grade 9-12. The sampling was done in all the states and the District of Columbia. It was a three-stage cluster sample design that provided a nationally representative sample of students in grades 9-12 who attended public and private schools (Kann, 2015). Survey design ensured protection of the privacy of the participants and allowed for voluntary participation. Permission was also sort and obtained from parents. It was a self-administered questionnaire, completed by the students (Kann, 2015). Details of methodology of the national, state, and large urban schools YRBSS can be found elsewhere (Brener et al., 2013).

2.2.2. Questionnaire

Detailed description of the questionnaire used can be found elsewhere (https://www.cdc.gov/healthyyouth/data/yrbs/questionnaires.htm)

2.2.3. Outcome Variable

Dating violence was defined as having experienced either physical or sexual dating violence. To ascertain physical dating violence, participants were asked the question “During the past 12 months, how many times did someone you were dating or

going out with physically hurt you on purpose?". Physical dating violence included such things as being hit, slammed into something, or injured with an object or weapon. Sexual dating violence was ascertained by the question "During the past 12 months, how many times did someone you were dating or going out with force you to do sexual things that you did not want to do?" Sexual dating violence included such things as kissing, touching, or being physically forced to have sexual intercourse. For both physical and sexual dating violence the responses were A = "I did not date or go out with anyone during the past 12 months", B =0 times, C = 1 time, D = 2 or 3 times, E = 4 or 5 times and, F = 6 or more times. The responses were recoded as 0 = zero physical/sexual dating violence and, 1 = one or more physical/sexual dating violence.

From the above three dating violence variables were created: physical dating violence, sexual dating violence and combined physical and sexual dating violence. Each of the variables were categorized as 0 (zero experiences physical/sexual dating violence) and 1 (one or more experiences of physical/sexual dating violence).

2.2.4. Exposure Variables

Substance use was defined as having used or not used substances (alcohol, tobacco, select illicit drugs, and marijuana) during the past 30 days. Select illicit drugs included cocaine, inhalants, heroin, methamphetamine, hallucinogens, and ecstasy. Alcohol use was ascertained with the questions "During the past 30 days, on how many days did you have at least one drink of alcohol?", tobacco use was ascertained with the question, "During the past 30 days, on how many days did you smoke cigarettes?", while marijuana use was ascertained with the question "During the past 30 days how many times did you use marijuana?". If a person did not use a substance within the last

30 day, it is coded as “0’ (not used) while any use of a substance either once or multiple times was coded as 1 (used). For select illicit drugs, use of any of the components of “select illicit drugs’ qualifies as “use of select illicit drugs”. This includes use of one or more of cocaine, inhalants, heroin, methamphetamine, hallucinogens, and ecstasy.

Non-use of any of them, is coded as 0, while use of any of them is coded as 1. As shown in table 2.0, to determine polysubstance use, the variables were recoded as “not used” where all four substances were 0 (alcohol = 0, select illicit drugs = 0, tobacco = 0 and, marijuana = 0), used alcohol only (alcohol = 1, tobacco = 0, select illicit drugs = 0, and, marijuana = 0), used tobacco only (alcohol = 0, tobacco = 1, select illicit drugs = 0, and, marijuana = 0), used marijuana only (alcohol = 0, tobacco = 0, select illicit drugs = 0, and, marijuana = 1), used select illicit drugs only (alcohol = 0, tobacco = 0, select illicit drugs = 1, and, marijuana = 0), used alcohol and select illicit drugs, (alcohol = 1, select illicit drugs = 1, tobacco = 0 and, marijuana = 0), used alcohol and tobacco (alcohol = 1, select illicit drugs = 0, tobacco = 1, and marijuana = 0), used alcohol and marijuana (alcohol = 1, select illicit drugs = 0, tobacco = 0 and, marijuana = 1), used tobacco and marijuana (alcohol = 0, tobacco = 1 and, marijuana = 1), , tobacco and select illicit drugs, (alcohol = 0, select illicit drugs = 1, tobacco = 1 and, marijuana = 0), , used marijuana and select illicit drugs, (alcohol = 0, select illicit drugs = 1, tobacco = 0 and, marijuana = 1), and, used three or more substances : tobacco+ marijuana + select illicit drugs (tobacco = 1, marijuana = 1, and select illicit drugs), tobacco+ marijuana + alcohol (tobacco = 1 and, marijuana = 1 alcohol = 1), tobacco+ alcohol + select illicit drugs (tobacco = 1, alcohol = 1, and, select illicit drugs = 1), alcohol + marijuana + select illicit drugs (alcohol = 1, marijuana = 1 and select illicit drugs = 1), alcohol +

tobacco + marijuana + select illicit drugs (alcohol = 1, tobacco = 1 marijuana = 1, and select illicit drugs = 1).

Table 2.1

Coding substance use to generate the mono-substance, and polysubstance use variables

Substance used	Alcohol	Marijuana	Tobacco	Select illicit drugs
Used alcohol only	1	0	0	0
Used marijuana only	0	1	0	0
Used tobacco only	0	0	1	0
Used select illicit drugs only	0	0	0	1
Used alcohol and tobacco	1	0	1	0
Used alcohol and marijuana	1	1	0	0
Used tobacco and marijuana	0	1	1	0
Used tobacco and select illicit drugs	0	0	1	1
Used marijuana and select illicit drugs	0	1	0	1
Used alcohol and select illicit drugs	1	0	0	1
Used alcohol, tobacco and select illicit drugs	1	0	1	1
Used alcohol, marijuana and tobacco	1	1	1	0
Used tobacco, marijuana, & select illicit drugs	0	1	1	1
Used alcohol, marijuana, & select illicit drugs	1	1	0	1
Used alcohol, tobacco, marijuana, & select illicit drugs	1	1	1	1

Footnote: In the table above, 0 = did not use the particular substance, and 1= used the particular substance

Finally, the variables were then combined to form the polysubstance use variable where those who did not use any substance were coded as “no substance use”, all single substance use was coded as “mono-substance use”, all combination of two

substances was coded as dual-substance use, while three or more substances use was coded as polysubstance use. We used “single substance use” as the reference in our study to understand how abstinence from any substance use and the use of more than one substance (two or more) compared to the use of just one substance.

2.2.5. Covariates

Covariates included self-reported age which was ascertained with the question “How old are you?”, and self-reported sex which was ascertained with the question “What is your sex?” and documented as “male” or “female”. Self-reported race was determined by the question “What is your race?” and documented as White, American Indians, Asians, Blacks, and Native Hawaiians. Ethnicity was determined with the question “Are you Hispanic or Latino?” with responses of “Yes” or “No”. Night sleep duration was assessed with the question “On an average school night, how many hours of sleep do you get?” The responses ranged from less than 4 hours to 10 hours or more. These were recoded as 1 = less than 8 hours and 2 = greater than or equal to 8 hours. The 8 hours cutoff is based on the minimal number of night-time sleep hours recommended by both the National Sleep Foundation and the American Academy of Sleep Medicine. This minimum sleep hours ensures that the adolescent gets adequate sleep to maintain physical and emotional wellbeing as well as maintain school performance (Suni (2020), National Sleep Foundation, 2020).

Academic grade was assessed by the question “During the past 12 months, how would you describe your grades in school?” This included grades A to F. This was further recoded as 1 = grades A and B, and 2 = grades C to F. The cutoff is based on academic grade B which separates excellent academic performance from less excellent

performances. Concentration/decision making was assessed by the question “Because of a physical, mental, or emotional problem, do you have serious difficulty concentrating, remembering, or making decisions?”. The response was A = Yes and B= No. This was recoded as 0 = No and 1 = Yes.

2.3.1. Statistical Analysis

Descriptive analyses were used to examine the demographic characteristics and the prevalence of dating violence in the sample of high school students. Bivariate analysis was used to determine the association of dating violence and polysubstance use. Multiple logistic regression analyses were used to examine the association between polysubstance use and dating violence after adjustment for age, sex, race, ethnicity, night sleep duration, academic grade and, concentration/decision making.

We checked the interactions between sex and academic grade as well as between race and ethnicity and found no significant interaction. We also did a Hosmer-Lemeshow’s goodness of fit to ascertain that the model fits the data. We examined the relationship between adolescent dating violence and the associated covariates. The first model was used to demonstrate the unadjusted relationships between polysubstance use and dating violence with single substance as the reference. The second model demonstrated the adjusted relationships between polysubstance use and dating violence with the same reference as mentioned above. All the analyses were performed using the Statistical Analysis System (SAS) software package version 9.4 (SAS Institute Inc., Cary, NC, USA).

2.4. Results

2.4.1. Sociodemographic Characteristics of the Study Population

Our study population were adolescents aged 13-19 years old (n = 13,677). Majority of the population sample (63%) were younger than 17 years of age, 51% of the population were males and 61% of the study population were Whites. Thirteen percent were Blacks, 74% were Non-Hispanics, 78% reported less than 8 hours of night sleep and about 75% reported excellent academic grades.

The prevalence of physical dating violence was 8.2%. Also, 8.2% of the study population reported experiencing sexual dating violence in the 12 months prior to the survey. Only about 2.6% of our study population had experienced both physical and sexual dating violence within the same time period. Among the participants who experienced physical dating violence, 46% were 17 years or older, 58% were females, 63% were Whites, 17% Blacks and 20% of other racial groups. Only 29% were of Hispanic ethnicity while 18% had 8 or more hours of night sleep. Majority (62%) of the participants who experienced physical dating violence had good academic grades but about 60% of them had problems with concentration, memory, or recall.

Among those who experienced sexual dating violence 77% were females and 57% were younger than 17 years of age. Regarding the experiencing of sexual dating violence by racial groups, Whites made up 71%, and Blacks constituted 12% of those who experienced sexual dating violence (Table 2.2). About 64% of those who reported experiencing both physical and sexual dating violence were females, while 65% of them were Whites. A lesser proportion of the study population who experienced both physical

and sexual dating violence had excellent academic performance (38%) or had night sleep durations of 8 hours or more (14%).

Table 2.2:

Sociodemographic Characteristic of the Study Population

	Physical Dating violence			***Sexual Dating violence***			***Physical & Sexual Dating violence***		
	N (%)	χ^2	***P value***	**N (%)**	χ^2	***P value***	**N (%)**	χ^2	***P value***
Sex									
Female	409 (58)	15.8	0.0072	477 (77)	175	<0.0001	145 (64)	16.8	0.0028
Male	301 (42)			146 (23)			82 (36)		
Race									
Whites	406 (63)	18.4	0.0152	408 (71)	7.4	0.1666	135(65)	5.1	0.4732
Blacks	107 (17)			67 (12)			32 (15)		
Others	129 (20)			100 (17)			42 (20)		
Ethnicity									
Non-Hispanic	503 (71)	2.4	0.2115	446 (71)	0.4	0.6395	163 (71)	1.0	0.5292
Hispanic	204 (29)			180 (29)			68 (29)		
Sleep duration									
< 8 Hours	571 (82)	1.8	0.3221	512 (84)	9.1	0.0328	192 (86)	5.2	0.0894
≥ 8 Hours	129 (18)			94 (16)			32 (14)		
Academic grade									
Grades A&B	424 (62)	45	<0.0001	422 (70)	4.0	0.0866	83 (38)	12.7	0.0062
Grades C to F	264 (38)			184 (30)			137 (62)		
Problems with Concentration									
No	208 (40)	86	<0.0001	198 (37)	123	<0.0001	133 (66.5)	52	<0.0001
Yes	316 (60)			342 (63			67 (33.5)		

2.4.2. Association between Study Covariates and Adolescent Dating Violence

Table 2.3 shows the relationship between dating violence and its covariates. Males were 30% less likely to experience physical dating violence compared to females (OR = 0.69, 95% CI = 0.57 – 0.94, p = 0.0178) and for sexual dating violence, males were about 70% less likely to experience sexual dating violence than females (OR = 0.28, 95% CI = 0.21 – 0.38, p = <0.0001). The relationship was similar for those who experienced both physical and sexual dating violence where males had a 30% less likelihood of experiencing dating violence compared to the females (OR = 0.70, 95% CI = 0.47 – 0.93, p = 0.0202).

Those with poorer academic grades (C to F) were about 40% less likely to experience physical dating violence than those with higher grades (OR = 0.61, 95% CI = 0.45 – 0.78, p = 0.0006). Participants with poorer academic grades were 30% less likely (OR = 0.73, 95% CI = 0.44 – 0.96, p = 0.0330) to have experienced both physical and sexual dating violence compared to those with better academic grades. Also, those who had problems with concentration/memory/decision making, were 2.3 times (OR = 2.32, 95% CI = 1.78 – 2.99, p = < 0.0001) more likely to experience physical dating violence, 2.4 times (OR = 2.38, 95% CI = 1.91 – 3.02, p = <0.0001) more likely to experience sexual dating violence and 2.8 times (OR = 2.79, 95% CI = 1.94 – 4.01, p = <0.0001) more likely to experience both physical and sexual dating violence compared to those who had no problems with concentration/memory/decision making.

Table 2.3:

Multivariable Association between Dating Violence and Covariates among Adolescents

	Physical Dating Violence		Sexual Dating Violence		Both Physical and Sexual Dating Violence	
	Adjusted OR (95% CI)	**p value**	**Adjusted OR (95% CI)**	**p value**	**Adjusted OR (95% CI)**	**p value**
Sex						
Female						
Male	0.69(0.57 – 0.94)	0.0178	0.28(0.21 – 0.38)	<0.0001	0.70(0.47 – 0.93)	0.0202
Race						
Whites						
Blacks	1.31(0.99 – 1.79)	0.5424	0.92(0.55 – 1.54)	0.7983	1.63(0.79 – 3.03)	0.6747
Others	1.10(0.75 – 1.69)	0.2416	1.12(0. 74 –1.74)	0.3890	1.61(0.87 – 2.95	0.5412
Ethnicity						
Non-Hispanic						
Hispanic	0.89(0.77 – 1.25)	0.8557	1.00(0.76 – 1.36)	0.9218	0.82(0.44 – 1.49)	0.4962
Sleep duration						
< 8 Hours						
≥ 8 Hours	0.92(0.63 – 1.37)	0.7012	0.82(0.52 – 1.15)	0.1880	0.60 (0.33 – 1.06)	0.0763
Academic grade						
Grades A&B						
Grades C to F	0.61(0.45 – 0.78)	0.0006	0.80(0.62 – 1.04)	0.0889	0.73(0.44 – 0.96)	0.0330
Problems with Concentration						
No						
Yes	2.32(1.78 – 2.99)	<0.0001	2.38(1.91 – 3.02)	<0.0001	2.79 (1.94 – 4.01)	<0.001

2.4.3. Associations between Polysubstance Use and Adolescent Dating Violence

Table 2.4 shows the unadjusted relationship between polysubstance use and adolescent dating violence. Both in the unadjusted and the adjusted relationships, there were no significant relationships between dual substance use and physical dating violence, sexual dating violence and combined physical and sexual dating violence. There was no significant difference in the odds of dating violence for those who used a combination of two substances when compared to those who used single substances only. Compared to those who used only single substances, adolescents who did not use any substance were 60% less likely (OR = 0.42, 95% CI = 0.24 – 0.74, p <0.0001) to experience physical dating violence, 50% less likely (OR = 0.45, 95% CI = 0.31 – 0.66, p <0.0001) to experience sexual dating violence and 70% less likely (OR = 0.34, 95% CI = 0.16– 0.69, p <0.0001) to have experienced both physical and sexual dating violence.

Adolescents who used polysubstance were 2.5 times likely (OR = 2.45, 95% CI = 1.58 – 3.80, p <0.0001) to experience physical dating violence compared to those who used only single substances. They were also about 2.1 times (OR = 2.13, 95% CI = 1.42 – 3.20, p <0.0001) more likely to experience sexual dating violence and 2.6 times (OR = 2.64, 95% CI = 1.38 – 5.04, p <0.0001) more likely to have experienced both physical and sexual dating violence.

Table 2.4:

Bivariate Association between Polysubstance Use and Dating Violence (DV) among Adolescents

	Physical DV		Sexual DV		Both Physical and Sexual DV	
	Crude OR (95% CI)	**p value**	**Crude OR (95% CI)**	**p value**	**Crude OR (95% CI)**	**p value**
Sex						
Female						
Male	0.73 (0.58 – 0.93)	0.0108	0.27 (0.21 – 0.36)	<0.0001	0.57 (0.39 – 0.83)	0.0047
Race						
Whites						
Blacks	1.25 (0.96 – 1.63)	0.9384	0.82 (0.60 – 1.12)	0.1955	1.13 (0.64 – 2.01)	0.9979
Others	1.55(1.11 – 2.16)	0.0763	1.20 (0.84 – 1.71)	0.0932	1.48 (0.93 – 2.36)	0.1545
Ethnicity						
Non-Hispanic						
Hispanic	1.14 (0.92 – 1.42)	0.2207	1.07 (0.81 – 1.40)	0.6416	1.16 (0.72 – 1.86)	0.5309
Sleep duration						
< 8 Hours						
≥ 8 Hours	0.87 (0.66 – 1.15)	0.3259	0.69 (0.48 – 0.99)	0.0424	0.64 (0.38 – 1.09)	0.1013
Academic grade						
Grades A&B						
Grades C to F	0.56 (0.44 – 0.72)	<0.0001	0.83 (0.65 – 1.04)	0.0979	0.61 (0.41 – 0.89)	0.0124
Problems with Concentration						
No						
Yes	2.54 (1.97 – 3.28)	<0.0001	3.02 (2.44 – 3.72)	<0.0001	3.18 (2.14 – 4.72)	<0.0001
Polysubstance						
Single substances						
No substance Use	0.42 (0.24 – 0.74)	<0.0001	0.45 (0.31 – 0.66)	<0.0001	0.34 (0.16 – 0.69)	<0.0001
Dual substance	1.06 (0.72 – 1.57)	0.7047	1.15 (0.82- 1.63)	0.2175	0.80 (0.41 – 1.58)	0.4431
Polysubstance	2.45 (1.58 – 3.80)	<0.0001	2.13 (1.42 – 3.20)	<0.0001	2.64 (1.38 – 5.04)	<0.0001

Footnote: In the polysubstance variable, we used single substance use as the reference value and compared it both to "Used no substance" and polysubstance use (Dual substance use and Multi substance use)

After adjusting for possible confounders (Table 2.5), the direction of the relationships remained the same. Adolescents who did not use any substances were 50% less likely (OR = 0.49, 95% CI = 0.27 – 0.89, p <0.0002) to have experienced physical dating

violence and 40% less likely (OR = 0.56, 95% CI = 0.38 – 0.83, p <0.0001) to have experienced sexual dating violence.

Table 2.5:

Multivariable Association between Polysubstance Use and Dating Violence (DV) among Adolescents

	Physical DV		**Sexual DV**		**Both Physical and Sexual DV**	
	Crude OR (95% CI)	**p value**	**Crude OR (95% CI)**	**p value**	**Crude OR (95% CI)**	**p value**
Sex						
Female						
Male	0.64 (0.46 – 0.88)	0.0081	0.22 (0.14 – 0.32)	<0.0001	0.49 (0.29 – 0.81)	0.0072
Race						
Whites						
Blacks	1.43 (0.98 – 2.07)	0.3739	0.90 (0.48 – 1.72)	0.5437	1.60 (0.69 – 3.71)	0.7863
Others	1.39 (0.81 – 2.40)	0.4974	1.16 (0.78 – 1.73)	0.5675	1.54 (0.90 – 2.64)	0.7785
Ethnicity						
Non-Hispanic						
Hispanic	0.94 (0.69 – 1.30)	0.7154	1.05 (0.76 – 1.46)	0.7631	0.99 (0.51 – 1.94)	0.9785
Sleep duration						
< 8 Hours						
≥ 8 Hours	1.21 (0.81 – 1.82)	0.3398	0.84 (0.54 – 1.31)	0.4340	0.78 (0.37 – 1.67)	0.5089
Academic grade						
Grades A&B						
Grades C to F	0.66 (0.51 – 0.87)	0.0037	0.93 (0.69 – 1.26)	0.6347	0.72 (0.44 – 1.12)	0.1642
Problems with Concentration						
No						
Yes	2.27 (1.76 – 2.92)	<0.0001	2.20 (1.63 – 2.95)	<0.0001	2.4 2 (1.50 – 3.90)	0.0007
Polysubstance	0.49 (0.27 – 0.89	0.0002	0.56 (0.38 – 0.83)	<0.0001	0.46 (0.22 – 0.94)	0.0004
Single substances	1.07 (0.69 – 1.66)	0.6833	1.18 (0.76 – 1.83)	0.4713	0.98 (0.49 - 1.94)	0.7005
No substance Use	2.10 (1.27 – 3.47)	<0.0001	2.11 (1.34 – 3.34)	<0.0001	2.75 (1.34 – 5.61)	<0.0001
Dual substance						
Polysubstance						

Footnote: In the polysubstance variable, we "used single substance" as the reference value and compared it both to "Used no substance" and polysubstance use (Dual substance use and Multi substance use)

They were about 50% less likely (OR = 0.46, 95% CI = 0.22 – 0.94, p <0.0004) to have experienced a combination of physical and sexual dating violence when compared to those who used only one form of substance. Compared to adolescents who used single substances, adolescents who used polysubstance were 2.1 times (OR = 2.10, 95% CI = 1.27 – 3.47, p <0.0001) more likely to have experienced physical dating violence and 2.1 times (OR = 2.11, 95% CI = 1.34 – 3.34, p <0.0001) more likely to have experienced sexual dating violence. Adolescents who used polysubstance are also 2.8 times (OR = 2.75, 95% CI = 1.34 – 5.61, p <0.0001) more likely to have experienced both physical and sexual dating violence compared to those who used only a single substance.

2.5. Discussion

Even though previous studies have examined the prevalence of dating violence, their findings seem to be higher than what we have reported in our study. For example, Silverman et al (2001) reported a prevalence of either of physical or sexual dating violence to be 20%, but our study found lower prevalence. Another study even reported the prevalence of physical dating violence to be 35% (Haynie et al, 2013). Among our study population, the prevalence of physical dating violence was 8.2%, sexual dating violence was also 8.2%, while a combination of both physical and sexual dating violence was only 2.6%. Previous reports from the Youth Risk Behavior Surveillance System (YRBSS, 2007 - 2017) indicate that the prevalence of physical dating violence across states varied from 7.4% to 17.8% with a median of 11.1 percent. Our study finding for adolescent physical dating violence falls within this reported range (7.4% - 17.8%) but is still lower than the reported median value of 11%.

The reported prevalence of adolescent sexual dating violence ranged from 3 to 11 percent, and though these are lower than the prevalence of physical dating violence, they are inclusive of the 8.2% prevalence of sexual dating violence found in our study. The lower prevalence of dating violence in our study could possibly be explained by some incidences of adolescent dating violence that are not reported by those adolescents who experienced them. This possible under-reporting of adolescent dating violence may have introduced information bias to the study and therefore affected the findings. The higher prevalence reported in earlier studies (Silverman et al, 2001) must be considered in the context of this possible under-reporting of dating violence among adolescents compared to older individuals or the general population. It also provides opportunities for research into the possible factors contributing to the lower reported prevalence of adolescent dating violence compared to other population groups.

The study population consisted of an evenly distributed population by gender, with males and females represented in equal proportion, but for every form of dating violence including a combination of physical and sexual dating violence, a higher proportion of those affected were females. The prevalence of physical, sexual, and combined physical and sexual dating violence was higher among Whites than any other racial groups and differs from previous reports (CDC, 2006) that dating violence victimization occurred more frequently among Blacks than other racial groups. Our study shows that for each of physical, sexual and a combination of both physical and sexual dating violence, Blacks constituted the least proportion of those affected when considering the racial groups of Whites, Blacks and Others (other racial groups combined).

From our study, males were less likely to experience dating violence of any form when compared to females. Also, people who performed poorly in their academics were less likely to experience physical dating violence than those who performed better. These findings are not fully understood and may need to be investigated further. Adolescents who had problems with concentration and decision making were more likely to have reported experiencing all forms of adolescent dating violence with increasing odds as we moved from physical dating violence to sexual dating violence and then to a combination of the two. This shows that the odds of dating violence for adolescents with concentration and memory problems was higher for sexual dating violence compared to physical dating violence, and even higher for combined physical and sexual dating violence compared to sexual dating violence. However, because our study is cross-sectional, we cannot report on the temporal relationship between decision making capacity and the likelihood of experiencing dating violence. It is also possible that dating violence had occurred before the problems with concentration and memory, and that the poor concentration and poor memory were coping mechanisms for the dating violence that adolescents experienced. We cannot however understand the true temporal relationship between dating violence and concentration problems because of the nature of the data set we used.

Compared with previous studies, we reported lower prevalence of substance use. Unlike in previous studies that reported 67% prevalence of alcohol (Johnson et al, 2014) and 50% prevalence of marijuana (PartnershipTM, 2013) and 40% prevalence of tobacco (Kahn et al, 2014), we found much lower prevalence of use of those substances in our study population. The prevalence of alcohol use in our study was

29%, that of marijuana was 22% and tobacco use was 37%. Other population characteristics such as access to substances, and willingness to report substance use may explain these differences.

Adolescents who did not use any substances were at lower odds of experiencing physical, sexual and dual physical and sexual dating violence compared to those who used only a single substance. This is consistent with other studies which reveal that adolescents who reported frequent recent alcohol use were at increased odds of experiencing physical dating violence compared to students who did not use alcohol (Parker et al,2016). Consistent with previous studies (Parker and Bradshaw, 2015) which showed that adolescents who had experienced physical and psychological dating violence were more likely to have used a combination of alcohol and marijuana, our study did not find similar results. Single marijuana, alcohol, or combination of both presented higher odds of physical, sexual, and combined sexual and physical dating violence compared to adolescents who did not use any substance. However, adolescents who used a combination of two substances did not show significant differences in the odds of experiencing any form of dating violence when compared to those who used single substances.

The few studies on polysubstance use considered only the combined use of two substances and rarely considered three or more substance use. Our study is unique in that it examined the use of no substances, use of a single substance, dual substances, and polysubstance. Polysubstance use in our study ranged from the use of two to the use of a maximum of four substances within the 30 days prior to the survey but was further divided into combined use of two substances and combined use of three or more

substances. Our finding of the increased odds of dating violence with polysubstance use is consistent with other research (Parker and Bradshaw, 2015) in showing that polysubstance use is associated with experiencing sexual and physical dating violence among adolescents.

However, those finding were for combination of two substances which differ from our findings that combination of two substances only did not increase the odds of dating violence when compared to those who used only single substances. Although we did not find any previous reports of the association of the use of up to four substances with dating violence, our study shows that adolescents who used multiple substances (three or more combination of substances) were at increased odds of experiencing any form of dating violence when compared to their counterparts who used only single substances. Our study shows that the odds of experiencing dating violence is highest for participants who used three or more substances and least likely for those who used no substance. We also showed that the use of two substances combined does not portray a higher odd of experiencing dating violence compared to the use of a single substance.

However, those who combined two substances were still at higher odds of experiencing any form of dating violence compared to those who did not use any substance at all. We can therefore infer that adolescents who do not use substances are at lowers odds of experiencing dating violence compared to those who use even a single substance. We also found that the odds of experiencing any form of dating violence becomes significant when adolescents used three or more substances compared to the use of only one substance. Emphasis should therefore be laid on preventing adolescents from commencing the use of substances- even a single

substance. We also notice that the beneficial effects of stopping the use of a single substance is higher for those that use three or more substances compared to those that used only two. There may not be any difference in the use of one or two substances, but the benefit is evident when considering three or more substances. This therefore indicates that scaling down polysubstance use one substance at a time, during substance use treatment may provide opportunities for the planning and implementation of preventive efforts towards reducing physical, sexual, and a combination of physical and sexual dating violence among adolescents in the United States.

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Chapter 3. Association between Polysubstance Use and Tendency for Criminal Arrest among Adolescents in the United States

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Abstract

Objective: Criminal arrests affect both the physical and mental wellbeing of individuals and constitutes a public health concern. Substance use is common among adolescents and may be associated with detrimental social and health outcomes. The aim of our study was to determine the prevalence of adolescent criminal arrests and explore the association between polysubstance use and adolescent criminal arrests.

Method: Data constituted of a sample of 63,777 participants aged 12 to 20 years who were admitted for substance use treatment in Treatment Episode Data Set -Admission (TEDS-A), 2018. The odds of criminal arrests were assessed among adolescents who used substances with the use of select illicit drugs as the reference. Multiple logistic regression was used to evaluate the association between polysubstance use criminal arrests among adolescents.

Results: About 17.5% of adolescents used at least one select illicit drugs alone, 7.6% combined select illicit drugs with alcohol, 55% combined select illicit drugs with marijuana and 19.7% combined of select illicit drugs, alcohol and marijuana. The prevalence of arrest was 17.2% with 14.3 percent having singular arrests and 2.8 % experiencing two or more arrests.

Compared to adolescents who used select illicit drugs alone, those who combined select illicit drugs with alcohol were 1.7 times more likely to be arrested (OR = 1.66, 95% CI = 1.49 – 1.85). Adolescents who combined select illicit drugs with marijuana were 1.5 times (OR = 1.46, 95% CI = 1.46 – 1.65) more likely to be arrested while those who used all three were 1.6 times (OR = 1.62, 95% CI = 1.50 – 1.75) more likely to be arrested than those who used only select illicit drugs.

Conclusion: Polysubstance use was associated with higher odds of arrests than the use of single substances. Prevention efforts towards reducing the rate of arrests and incarcerations, should focus on prevention of substance use initiation and discouragement of multiple substance use.

Keywords: criminal arrests, polysubstance use, alcohol, marijuana, select illicit drugs

3.1. Introduction

About 50 years ago, when then-President Richard Nixon declared a war on drug use, the escalation in the rate of arrests and incarcerations of illicit drug users was apparent (Alexander, 2014). Even though such laws may have been intended to be used equally across all racial groups, there was a disproportionately heavier burden of arrests and incarcerations among people of color when compared to Whites (Alexander, 2010). The penalties were also heavy even for low-level and first-time offenders and the structural changes in the war against illicit drug use did not apply equally to all sociodemographic groups (Dumont et al., 2012). For instance, the prevalence of illicit drug use was 9.6% among blacks and 8.8% among whites (SAMHSA, 2010). Illicit drugs are substances that may stimulate (e.g., cocaine) or inhibit (e.g., heroin) the central nervous system and are classified into two categories- one group is illegal to use, while the other group is legal to be prescribed by the physician by often ends up in the hands of people for whom it was not originally prescribed. Even though the prevalence of illicit drug use was 9.6% among Blacks, they were about 13 times more likely to be arrested and incarcerated than their White counterparts (Moore & Elkavich, 2008). It is noteworthy that these arrests were for illicit drug use and not for any other criminal activities related to drug use. Because substance use alters the functional capacities of individuals, this study seeks to understand how multiple substance use within the prior 30 days is associated with arrests for criminal activities among adolescents.

Criminal arrests are not only detrimental to the social standing of an individual, but they also affect both the physical and mental wellbeing of persons as well as

constitute public health concerns (Alexander, 2010, Drucker, 2011). Studies have shown that adolescent marijuana users have higher likelihood than non-users to have interactions with the criminal justice system with about 59% of heavy marijuana users having arrest records compared to 35% of non-users (Green et al., 2010). Also, heavy users were more likely to be arrested at younger ages compared to non-users. Past-year use of marijuana was most common among illicit drugs (26%), followed by misuse of medication (9%) and use of other illicit drugs (8%). During the past month, alcohol use was reported by more than one-third (35%), binge drinking by 27%, and cigarette smoking by 19% of the adolescent population (Conway, 2013). The findings from this national study of students indicate high rates of polysubstance use. The high level of depressive and somatic symptoms among polysubstance users indicates the need for mental health screening and referral (Conway, 2013).

In a study of poly-use of cannabis and other substances among juvenile justice-involved youths, researchers found that cannabis and alcohol use were more prevalent than single use of either alcohol, cannabis, or other drugs use (Banks et al., 2019). Polysubstance use was associated with lower scores on measures of intellectual functioning, more externalizing and internalizing symptomology, and more substance-related problems relative to cannabis only use. These findings suggest that justice-involved youths engaged in polysubstance use may be at greater need for concurrent academic, affective, and behavioral support in their rehabilitation and transition back to the community (Banks et al., 2019).

Substance abuse and conduct disorder were each associated with an increased risk of arrest (Sittner-Hartshorn, Whitbeck, & Prentice, 2015). Therefore, intervention

through early identification and treatment of related substance use and mental health disorders either prior to or at first contact with the criminal justice system may be crucial to curbing the public health consequences of polysubstance use and adolescent criminal arrests.

Even though Blacks have previously been found to be more likely to use most substances, a recent study (Racz et al., 2016), reported that Black adolescents were less likely to use polysubstance compared to their White or Latino counterparts. The conclusions from the same study indicate that interventions should be multifaceted to address the multitude of risk factors associated with polysubstance use among juvenile offenders from different cultural experiences (Racz et al., 2016). The aim of our study was to determine the prevalence of adolescent criminal arrests and explore the association between polysubstance use and adolescent criminal arrests. Our study has the potential to generate data to inform policies for addressing polysubstance use and its contributions to adolescent criminal arrests.

3.2. Methods

3.2.1. Study Population

The study sample consisted of 63,777 participants who were between 12 and 20 years of age and were admitted for substance use treatment in the United States. The sample was taken from the Treatment Episode Data Set -Admission (TEDS-A)-2018 which is a national data system of annual admissions to substance abuse treatment facilities. Some states collect only their publicly funded admissions while other states can also collect their privately funded admissions from facilities that receive public

funding. States then report these data from their state administrative systems to Substance Abuse and Mental Health Services Administration (SAMHSA). These data are then combined to form the resulting data system, referred to as TEDS-A. Thus, TEDS-A does not include all admissions to substance abuse treatment. It does, however, include that portion of admissions that would constitute public health burden for substance abuse treatment (SAMHSA, 2018).

TEDS-A contains demographics information on age, sex, race/ethnicity, employment status, and years of education, as well as substance abuse characteristics like substances used, age at first use, route of use, frequency of use, etc., as well as information on criminal arrests. In general, facilities reporting TEDS data are those that receive state alcohol and/or drug agency funds (including federal block grant funds) for the provision of alcohol and/or drug treatment services (SAMHSA, 2018).

3.2.2. Outcome Variable: Criminal Arrests

Criminal arrests indicate the number of times a client was arrested for any cause during the 30 days preceding the date of admission to treatment services. If the arrest was formal, it was documented irrespective of whether the outcome was a dismissal, conviction, or incarceration. The criminal arrests variable was coded as 0 (no arrest), 1 (arrested once), or 2 (arrested two or more times).

3.2.3. Exposure Variables: Polysubstance use

Substance use was defined as having used substances (alcohol, select illicit drugs, or marijuana) during the past 30 days. It is noteworthy that the data on tobacco use was not collected for this population group. Alcohol use, select illicit drugs use, and

marijuana use were all ascertained if the client reported any use of that substance within the 30 days preceding admission. If a person did not use a substance within the last 30 day, it was coded as “0’ (not used) while any use of a substance either once or multiple times was coded as 1 (used). Select illicit drugs include cocaine, inhalants, heroin, methamphetamine, hallucinogens, and other amphetamines.

Table 3.1

Coding substance use to generate the mono-substance, and polysubstance use variables

Substance used	Alcohol	Marijuana	Select illicit drugs
No substance use	0	0	0
Used alcohol only	1	0	0
Used marijuana only	0	1	0
Used select illicit drugs only	0	0	1
Used alcohol and marijuana	1	1	0
Used marijuana and select illicit drugs	0	1	1
Used alcohol and select illicit drugs	1	0	1
Used alcohol, marijuana, and select illicit drugs	1	1	1

Footnote: In the table above, 0 = did not use the particular substance, and 1= used the particular substance.

For select illicit drugs, use of any of the components of “select illicit drugs’ qualifies as “use of select illicit drugs”. This includes use of one or more of cocaine, inhalants, heroin, methamphetamine, hallucinogens, and other amphetamines. Non-use of any of them, is coded as 0, while use of any of them is coded as 1.

To determine polysubstance use, the variables were recoded as “not used” where all three substances were 0 (alcohol = 0, select illicit drugs= 0 and, marijuana = 0), used alcohol only (alcohol = 1, select illicit drugs = 0 and, marijuana = 0), used select illicit drugs only (alcohol = 0, select illicit drugs = 1 and, marijuana = 0), used marijuana only (alcohol = 0, select illicit drugs = 0 and, marijuana = 1), used alcohol and select illicit drugs (alcohol = 1, select illicit drugs = 1 and, marijuana = 0), used alcohol and marijuana (alcohol = 1, select illicit drugs = 0 and, marijuana = 1), used select illicit drugs and marijuana (alcohol = 0, select illicit drugs = 1 and, marijuana = 1), and, used all three substances (alcohol = 1, select illicit drugs = 1 and, marijuana = 1).

3.2.4. Covariates

Covariates included self-reported age which was ascertained with the question “How old are you?”, and self-reported sex which was ascertained with the question “What is your sex?” and documented as “male” or “female”. Self-reported race was determined by the question “What is your race?” and documented as Alaska Native, Asian or Pacific Islander, White, American Indian (other than Alaska Native), Native Hawaiian or Other Pacific Islander, Asian, Black or African Americans, other single race and two or more races. Race was further recoded as Black or African Americans = 1, White = 2 and Others = 3 (Alaska Native, Asian or Pacific Islander, American Indian (other than Alaska Native), Native Hawaiian or Other Pacific Islander, Asian, Other single races, and two or more races). Others was made up of racial groups which individually did not make up to 5% of the total population sample.

Years of education was used to determine the highest school grade completed by the client. Education was coded as 1 (8 years or less), 2 (9-11 years), 3 (12 years or

GED), 4 (13 – 15 years or Associate degree) and 5 (16 years or more). This was recoded as 1 = less than associate degree (8 years or less, 9-11 years, and 12 years or GED), 2 = Associate degree and, 3 = Bachelor's degree or higher. Employment status designated the client's employment status at the time of admission or transfer and coded as 1 (full-time), 2 (part-time), 3 (unemployed) and 4 (not in the labor force).

3.3.1. Statistical Analysis

Descriptive analysis was used to display the prevalence of criminal arrests as well as the prevalence of the predictor variables in the sample of adolescents admitted for substance use treatment. Bivariate analysis was used to determine the association of criminal arrests with age, sex, race, educational level, employment status, and polysubstance use. Multiple logistic regression analyses were used to examine the association between adolescent criminal arrests and polysubstance use after adjustment for the covariates. In our model, the association between adolescent criminal arrests and polysubstance use (different combinations of alcohol, select illicit drugs, and marijuana use) was assessed, while using select illicit drugs only (alcohol = 0, select illicit drugs = 1 and, marijuana = 0) as the reference level. Select illicit drugs was used as reference group because it was the only variable that represented single substance use. All the analyses were performed using the Statistical Analysis System (SAS) software package version 9.4 (SAS Institute Inc., Cary, NC, USA).

3.4. Results

3.4.1. Sociodemographic Characteristics of the Study Population

Table 3.2:

Demographic Characteristics of the Study Population

Frequency of Arrests by Socio-demographic and Predictor Variables

	No Arrests N (%)	One Arrest N (%)	Two or More Arrests N (%)	$\chi 2$	P value
Age					
< 17 years	25140 (49.9)	5686 (65.4)	1122 (65.1)	820	<0.0001
17 years and older	25214 (50.1)	3013 (34.6)	602 (34.9)		
Sex					
Male	17267 (34.3)	2317 (26.6)	428 (24.8)	250	<0.0001
Female	33058 (65.7)	6380 (73.4)	1296 (75.2)		
Race					
White	28133 (58.2)	4641 (54.9)	801 (48.4)	712	<0.0001
Blacks	9248 (19.1)	2396 (28.4)	619 (37.4)		
Others	10966 (22.7)	1411 (16.7)	234 (14.2)		
Education					
< Associate degree	45454 (95.6)	8086 (97.4)	1529 (98.5)	84	<0.0001
Associate degree	1883 (4.0)	203 (2.4)	22 (1.4)		
>= Bachelor's degree	216 (0.5)	17 (0.2)	2 (0.13)		
Employment Status					
Employed	8956 (18.9)	996 (11.9)	145 (8.9)	682	<0.0001
Unemployed	10907 (23.0)	1370 (16.3)	301(18.4)		
Not in labor force	27647 (58.2)	6028 (71.8)	1188 (72.7)		
Polysubstance Use					
Select illicit drugs only	8538 (17.0)	1742 (20.0)	368 (21.4)		
Alcohol + select illicit drugs only	4050 (8.0)	519 (6.0)	75 (4.4)	174	<0.0001
Marijuana + select illicit drugs only	27636 (54.9)	4858 (55.9)	1039 (60.3)		
Alcohol + Marijuana + select illicit drugs	10130 (20.1)	1580 (18.2)	242 (14.0)		

Footnote: All participants used at least one form of select illicit drug (cocaine, heroin, methamphetamine, other amphetamines, hallucinogens, inhalants) accounting for the 100% use of select illicit drugs in the population. Some combinations of drugs showed empty cells (used alcohol only, used marijuana only, used alcohol + marijuana only) and were therefore not represented on the tab.

The study population consists of United States adolescents within the age range of 12 to 20 years who were admitted for drug use treatment. About 52 percent of the population were younger than 18 years. About two-thirds of the population were males. Majority of the population were Whites (57.5%), Blacks made up 21% while other racial groups combined, made up the remaining 21% (Table 3.2). Ninety six percent of the population had less than an associate degree, about 3.7% had an associate degree and less than 1% had bachelor's degree or higher. About 17.6% of the population were adolescents who had either a full time or part time employment, 22% who were unemployed and about 60% were not in the labor force.

3.4.2. Polysubstance Use and Arrest Characteristics of the Study Population

Substance use was prevalent in the study population. About 27% of the population used alcohol in combination with other substances, and 75% used marijuana in combination with at least one other substance. Every participant who used either alcohol or marijuana, combined it with another substance. None of the participants used alcohol alone, marijuana alone or just a combination of alcohol and marijuana alone. All participants used at least one of the six components of select illicit drugs (cocaine, heroin, methamphetamines, other amphetamines, hallucinogens, and inhalants) either alone or in combination with other substances. About 17.5% used select illicit drugs alone, 7.6% combined select illicit drugs with alcohol, 55% combined select illicit drugs with marijuana while 19.7% used a combination of select illicit drugs, alcohol, and marijuana.

About 67% of those who used select illicit drugs only were 17 years and older, 54% of them were males, 67% were whites, 19% were Blacks, 96% had less than an

associate degree, 0.5% had an associate degree or more and 14% of them were employed. Among those who combined select illicit drugs with alcohol, 71% were 17 years and older, 59% were males, and 69% were Whites. Twenty seven percent of them were employed, and 46% were not in the labor force (Table 3.3).

Table 3.3:

Demographic Characteristics of the Study Population

Frequency of Polysubstance Use by Socio-demographic Variables

	Used Select illicit drugs only N (%)	Used Alcohol + Select illicit drugs only N (%)	Used Marijuana + Select illicit drugs only N (%)	Used Alcohol + Marijuana + Select illicit drugs	$\chi 2$	P value
Age	3469 (32.6)	1347 (29.0)	20614 (61.5)	6518 (54.5)	3825	<0.0001
< 17 years	7179 (67.4)	3297 (71.0)	12919 (38.5)	5434 (45.5)		
17 years and older						
Sex						
Male	4931 (46.4)	1922 (41.4)	9418 (28.1)	3741 (31.3)	1387	<0.0001
Female	5708 (53.6)	2719 (58.6)	24101 (71.9)	8206 (68.7)		
Race						
White	6726 (66.8)	3018 (69.0)	16744 (51.5)	7087 (61.7)	2081	<0.0001
Blacks	1958 (19.4)	356 (8.1)	8532 (26.2)	1417 (12.3)		
Others	1387 (13.8)	999 (22.8)	7244 (22.3)	2981 (26.0)		
Education						
< Associate degree	9075 (95.5)	3827 (87.2)	31231 (97.5)	10936 (95.3)	1108	<0.0001
Associate degree	382 (4.0)	528 (12.0)	712 (2.2)	486 (4.2)		
>= Bachelor's degree	48 (0.5)	36 (0.8)	94 (0.3)	57 (0.5)		
Employment Status						
Employed	1345 (13.9)	1185 (26.8)	4999 (15.6)	2568 (22.5)	1656	<0.0001
Unemployed	3166 (32.6)	1197 (27.0)	5923 (18.5)	2292 (20.1)		
Not in labor force	5198 (53.5)	2048 (46.2)	21053 (65.8)	6564 (57.5)		

Concerning those who combined select illicit drugs with marijuana, 72% were females, 26% were Blacks, 52% were Whites and 16% of them were employed. Of those who used all three substances, 22.5% were employed, 58% were not in the labor force, 69% were males, about 62% of them were Whites while 12.3% were Blacks.

The prevalence of arrest within the study population was 17.2%. About 14.3 percent have been arrested once while only 2.8 % of the study population had been arrested two or more times. As shown on Table 3.1, among those arrested twice, 65% where 17 years or younger, 75% were males and 48% were Whites.

About 37% of those arrested twice or more were Blacks. Among those with two or more arrest records, 98.5% had less than an associate degree and less than 1% had a bachelor's degree or higher. Among those with single arrest record, 71.8% were not in the labor force, 16.3% were unemployed while 11.9% were employed. For those with two or more arrest records, 8.9% were employed, 18.4% were unemployed and about 72.7% were not in the labor force. Among those that have two or more arrests, 21% used select illicit drugs, 4.4% combined select illicit drugs with alcohol, 60% combined select illicit drugs with marijuana, while 14% combined select illicit drugs with both alcohol and marijuana.

3.4.3. Association between Substance Use and Adolescent Criminal Arrests

As indicated on Table 3.4, there were significant associations between adolescent criminal arrests and each of age, sex, race, and employment status. In the bivariate association, adolescents who were 17 years or younger were 1.9 times (OR = 1.89, 95% CI = 1.81 – 1.97, $p < 0.0001$) more likely to be arrested than their younger

counterparts, and males were 1.5 times (OR = 1.48, 95% CI = 1.39 – 1.53, p <0.0001) more likely to be arrested than females.

Table 3.4:

Bivariate and Multivariable Associations between Covariates and Adolescent Criminal Arrests

	Criminal Arrests					
	Crude OR	**95% CI**	**p value**	**Adjusted OR**	**95% CI**	**p value**
Age						
< 17 years	1.89	1.81 – 1.97	<0.0001	1.68	1.56 – 1.75	<0.0001
17 years and older						
Sex	1.48	1.39 – 1.53	<0.0001	1.44	1.31 – 1.45	<0.0001
Female						
Male						
Race						
White						
Blacks	0.58	0.56 – 0.62	<0.0001	0.68	0.64 – 0.71	<0.0001
Others	1.30	1.22 – 1.37	<0.0001	1.47	1.42 – 1.61	<0.0001
Education						
<Associate degree						
Associate degree	1.77	1.54 – 2.04	0.3405	1.10	0.98 – 1.32	0.4071
>= Bachelor's degree	2.40	1.50 – 3.85	0.0144	1.68	0.99 – 2.80	0.0946
Employment Status						
Employed						
Unemployed	0.83	0.77 – 0.90	<0.0001	0.83	0.73 – 1.86	0.6700
Not in labor force	0.48	0.46 – 0.52	<0.0001	0.67	0.59 – 0.69	<0.0001

Participants who were not in the labor force were 50% (OR = 0.48, 95% CI = 0.46 – 0.52, p < 0.0001) less likely to be arrested than their employed counterparts, Blacks were 40% (OR = 0.58, 95% CI = 0.56 – 0.62, p < 0.0001) less likely to be arrested than their White counterparts while other racial groups combined were 1.3

times (OR = 1.30, 95% CI = 1.22 – 1.37, p < 0.0001) more likely to be arrested than their White counterparts. Compared to those who used select illicit drugs only, adolescents who combined select illicit drugs with alcohol were 3.9 times more likely to be arrested (OR = 3.91, 95% CI = 3.57 – 4.28, p <0.0001). Those who used both select illicit drugs and marijuana were 2.7 times (OR = 2.72, 95% CI = 2.60 – 2.84, p <0.0001) more likely to be arrested, while those who used all three substances (select illicit drugs, alcohol, and marijuana) were 3.3 times (OR = 3.29, 95% CI = 3.10– 3.49, p <0.0001) more likely to be arrested than those who used only select illicit drugs.

After adjusting for confounding variables, educational status still had no significant association with adolescent criminal arrests. Adolescents who were 18 years and older were 1.8 times more likely to be arrested than their younger counterparts (OR = 1.76, 95% CI =1.56 – 1.75, p < 0.0001), and males were 1.4 times (OR = 1.44, 95% CI = 1.31 – 1.43, p < 0.0001) more likely to be arrested than females. Blacks were 30% less likely to be arrested than their White counterparts (OR = 0.68, 95% CI = 0.64 – 0.71, p <0.0001) but other racial groups were 1.5 times more likely to be arrested than their White counterparts (OR = 1.47, 95% CI = 1.39 – 1.57, p <0.0001).

When compared to those who used select illicit drugs only (Table 3.5), adolescents who combined select illicit drugs with alcohol were 1.7 times more likely to be arrested (OR = 1.66, 95% CI = 1.49 – 1.85, p <0.0001). Those who used both select illicit drugs and marijuana were 1.5 times (OR = 1.46, 95% CI = 1.46 – 1.65, p <0.0001) more likely to be arrested than those who used only select illicit drugs. Also, those who used all three substances (select illicit drugs, alcohol, and marijuana) were 1.6 times

(OR = 1.62, 95% CI = 1.50 – 1.75, p <0.0001) more likely to be arrested than those who used only select illicit drugs.

Table 3.5

Bivariate and Multivariable Associations between Polysubstance use and Adolescent Criminal Arrests

	Criminal Arrests					
	Crude OR	**95% CI**	**p value**	**Adjusted OR**	**95% CI**	**p value**
Age						
< 17 years	1.89	1.81 – 1.97	<0.0001	1.76	1.65 – 1.86	<0.0001
17 years and older						
Sex						
Female						
Male	1.46	1.39 – 1.53	<0.0001	1.44	1.31 – 1.45	<0.0001
Race						
White						
Blacks	0.59	0.56 – 0.62	<0.0001	0.68	0.64 – 0.71	<0.0001
Others	1.29	1.22 – 1.37	<0.0001	1.47	1.39 – 1.57	<0.0001
Education						
<Associate degree						
Associate degree	1.77	1.54 – 2.04	0.3405	1.10	0.95– 1.28	0.3385
>= Bachelor's degree	2.40	1.50 – 3.85	0.0144	1.62	0.96 – 2.70	0.1048
Employment Status						
Employed						
Unemployed						
Not in labor force	0.83	0.77 – 0.90	<0.0001	0.56	0.45 – 0.69	<0.0001
	0.48	0.46 – 0.52	<0.0001	0.67	0.59 – 0.69	<0.0001
Polysubstance Use						
Select Illicit drugs only						
Alcohol + Select Illicit drugs	3.91	3.57 – 4.28	<0.0001	1.66	1.49 – 1.85	<0.0001
Marijuana + Select Illicit drugs	2.72	2.60 – 2.84	<0.0001	1.55	1.46 – 1.65	<0.0001
Alcohol + Marijuana + Select Illicit drugs	3.29	3.10 – 3.49	<0.0001	1.62	1.50 – 1.75	<0.0001

3.5. Discussion

There are not many studies on the association between polysubstance use and adolescent criminal arrests. One study indicated that about 10 million people are arrested per year in the U.S and about 16%of them are under the age of 21 years (Federal Bureau of Intelligence**,** 2020). About 1.5 million of such arrests are due to alcohol related offenses while about 1.6 million are arrested for other drugs offenses. Our study consisted of 63, 777 participants aged 12 to 20 years admitted for substance use treatment across the United States. We found a 27% prevalence of alcohol among this study population of United States adolescents, the prevalence of marijuana use was 75%, while every participant in the study used at least one of the select illicit drugs (cocaine, heroin, methamphetamine, other amphetamines, hallucinogens, or inhalants) Considering that the study participants were admitted for drug treatment, it is not surprising to find such high prevalence rates. The prevalence of alcohol does closely resemble those reported for adolescents in the 9^{th} to 12^{th} grades (Partnership TM, 2013) and according to Conway et al (2013), about 35% of the study population reported alcohol use with about 27% involved in binge drinking. Marijuana use had a higher prevalence in our study population, and this is different from findings in other study populations. Past-year use of marijuana as reported by Conway et al, was 26% (Conmay, 2013) which is lower than the prevalence of marijuana in our population. The fact that every participant in our study was on treatment for substance use may have contributed to the higher prevalence of marijuana and select illicit drugs and the result should be interpreted with this awareness.

Previous studies indicate that individuals who used marijuana were more likely to interact with the criminal justice system. Between 56 and 60 percent of individuals who combined select illicit drugs with marijuana in our study have been arrested at least once. This compares well with 59% of those who used marijuana in other studies who have interacted with the criminal justice system (Green et al., 2010).

About 8.1% of all adolescents who used combined alcohol and select illicit drugs in the study population were Blacks, with about 26% of all those who combined select illicit drugs and marijuana also from the same racial group. A higher percentage (61.7%) of adolescents who combined alcohol, marijuana and select illicit drug were Whites and about 12.3% of those who used all three substances were Blacks. Previous studies (SAMHSA, 2010) indicate a 9.6% prevalence of substance use among Blacks which is like the 12.3% for those who used all of alcohol, marijuana and select illicit drugs in our population.

On the average, about 62% of White adolescents in our study have used the three substance groups in any combination with other substances. This result is consistent with a recent study by Racz al., (2016) which showed that though Blacks are more likely to use single substances, they are less likely than their White and Latino counterparts to use polysubstance. According to one, Blacks were about 13 times more likely to be arrested and incarcerated than their White counterparts (Moore & Elkavich,2008) but our study shows that Blacks who used substances were 30 % less likely to be arrested for criminal offences compared to their White counterparts. This may be explained by the fact that the Moore and Elkavich studied the general population while our study is among adolescents on treatment for substance use. This

is also consistent with the higher proportion of our study population who are Whites, and the results should be interpreted in the light of the uniqueness of the study population.

In our study, less than one percent of the study population had a bachelor's degree or higher. Compared to the 96% of the study population who had less than an associate degree, the import of concurrent academic, affective, and behavioral support in the rehabilitation of drug-using adolescents as suggested by some studies (Banks et al., 2019) becomes more apparent. According to them polysubstance use was associated with lower scores on measures of intellectual functioning (Banks et al., 2019), and the low proportion (less than 1%) of college-educated participants who are involved in this drug-treatment admission study may highlights the possible roles of education on drug use. This finding presents opportunities for the role of education in drug use prevention among adolescents. Even though education may be related to poly substance use, our study did not find any indications that educational level is significantly related to adolescent criminal arrests. Participants with associate degrees and bachelor's degrees or higher are respectively 1.1 and 1.7 times more likely to be arrested than those with less than associate degrees, but these relationships are however not statistically significant and therefore do not reflect a true association between higher educational attainment and adolescent criminal arrests.

Adolescents who had any combination of select illicit drugs with alcohol or marijuana had higher odds of criminal arrest than adolescents who used only select illicit drugs. This corroborates the study by Hartshorn et al that substance use is associated with increased risks for criminal arrests. Our study went further by assessing how combination of substances relates to adolescent criminal arrests. All combinations

of polysubstance use in our study were statistically associated with adolescent criminal arrests with odds ratios ranging from 1.5 to 1.7 and indicates that adolescents who used polysubstance were more likely to be arrested than those who used select illicit drugs only. This finding agrees with another study which has shown that adolescents who used substances have are more likely to have interactions with the criminal justice system (Green et al., 2010).

In another study, Blacks were about 13 times more likely to be arrested and incarcerated than their White counterparts (Moore & Elkavich, 2008), but our study showed that Blacks who used polysubstance were 30 percent less likely to experience criminal arrests than their White counterparts. Our study also differs from the findings that there was a disproportionately heavier burden of arrests and incarcerations among people of color when compared to Whites (Alexander, 2010). These differences may be explained by the fact that the cited research studied the general population while ours studied adolescents on treatment for drug use. Even though alcohol and marijuana are the most used substances among adolescents, in our study population no participant used just alcohol or marijuana or a combination of the two alone. Therefore, our study could not ascertain the true prevalence of alcohol use alone, marijuana use alone, or a combination of both alone as the most used substances among adolescents (Center for Disease Control and Prevention, 2018.).

Like the conclusion from some studies (Racz et al., 2016), our study also indicates that interventions should be multifaceted to address the multitude of risk factors associated with polysubstance use among juvenile offenders from different cultural experiences. Also, the high prevalence of polysubstance use should be

concerning to both individuals and policy making authorities as attempts to reduce substance use could help decrease the number and proportion of adolescents arrested and/or incarcerated for both non-drug and drug-related offences.

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Chapter 4. Investigating the Association of Polysubstance Use with Weapon-related Injuries among High School Students in the United States

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Abstract

Objective: Injuries are the leading cause of death among adolescents and there is a growing concern about the increasing incidence of weapon-related injuries among this population group. Substance use is also a public health problem and polysubstance use is becoming prevalent among adolescents. The study aims to assess the prevalence of weapon-related injuries and investigate the association between polysubstance use and weapon-related injuries among adolescents.

Method: The data were obtained from the 2019 Youth Risk Behavior Surveillance System (YRBSS) (n= 13,677, age = 13-19 years), which monitors six categories of priority health-risk behaviors among youths and young adults including substance use and injuries. Multiple logistic regression analyses were used to examine the association between polysubstance use and weapon-related injuries after adjustment for age, sex, race, ethnicity, night sleep duration, and academic grade.

Result: The prevalence of weapon-related injuries was 7.4%. After adjusting for confounders there was no significant association between dual substance use and weapon-related injuries. Adolescents who used multi substances were 1.8 times (OR = 1.78, 95% CI = 1.18 – 2.68, p <0.0001) more likely to sustain weapon-related injuries while those who did not use substances were 50% less likely (OR = 0.47, 95% CI = 0.29 – 0.75, p <0.0001) to sustain weapon-related injuries compared to those who used only a single substance.

Conclusion: Use of polysubstance by adolescents was associated with increased odds of weapon-related injuries while adolescents who did not use substances had decreased odds of weapon-related injuries compared to those who used single substances. Efforts aimed at reducing weapon-related injuries among adolescents should focus on preventing substance use initiation and implement gradual but progressive reduction in the number of substances used by polysubstance using adolescent.

Keywords: polysubstance, adolescents, weapon-related injuries, alcohol, marijuana, tobacco, select illicit drugs.

4.1. Introduction

There is a growing concern about the increasing incidence of weapon-related injuries among high school students in the United States because of their public health importance and contributions to premature deaths and disability among children (Fowler et al., 2017). Injuries are the leading cause of death among children aged 4 to 18 years (Orton et al., 2016) and unintentional injuries are on the rise (Hemenway et al., 2011, Ozkan, 2016). Unintentional injuries represent one of four major causes of death among individuals aged 10-24 years (Eaton et al., 2008). Majority of the unintentional injuries occur during sport, though it is also seen in non-sports activities [Hemenway et al., 2011].

There is currently insufficient evidence to show that school-based programs are effective in reducing the incidence of injuries (Orton et al., 2016). In the research by Wahdan al. (2016), the overall prevalence of injuries in high schools was 68.5%. The factors that significantly contributed to sustaining injury included alcohol use, carrying a weapon, and being threatened by a weapon (Wahdan et al., 2016). In a recent study, weapon carrying was more prevalent among white adolescent students than any other racial group (Perlus et al., 2014). This analysis, however, did not specify weapon-related injuries.

There are many factors contributing to injuries among the high school age group including health-risk behaviors. Behaviors contributing to morbidity and mortality establish in individuals during childhood and extend into adulthood (Ozkan, 2016). There are indications that these behaviors are often interrelated but preventable (Eaton

et al., 2008). One of these such behaviors is substance use, the use of psychoactive substances including alcohol, tobacco, marijuana, and illicit drugs (WHO, 2018).

Substance use is reaching an epidemic among the youth population in the United States (U.S.). It is prevalent among students, and the behavior usually continues into adulthood (Ozkan, 2016). There is an association between substance use among high school students and adverse academic and health outcomes (Bugbee et al., 2019). There is also an association between substance use and significant risks to personal safety (Arria, 2017). Self-reported alcohol-related injuries were more likely to occur among those aged younger than 25 years (Coomber et al., 2017). Drug use was associated with having sustained two or more injuries in the past 12 months (Peltzer, 2017) and the association appears to be similar for both sexes.

Use of one substance does not preclude indulgence in other substances. In fact, studies have shown that youths who use one substance are likely to use other substance as well (Sampasa-Kanyinga, 2018). For instance, cannabis use is strongly associated with tobacco smoking and alcohol consumption (Sampasa-Kanyinga, 2018) but the relationship between this polysubstance use and weapon-related injuries has not been fully studied. The association between polysubstance use and weapon-related injury is therefore unknown and provides important stimulus for us to study this relationship.

Access to firearms is a potential risk for weapon-related injuries both among substance using and substance non-using adolescents. In the U.S, about 4.6 million minors live in homes with at least one loaded, unlocked firearm (Azrael et al., 2018). About 89% of accidental shooting deaths among children occur when children are

playing with unsecured, loaded guns creating a public health problem, and contributing substantially to premature death and disability among children (Fowler et al., 2017). A national cross-sectional survey in 2013 indicated that about 18% of high school students carried weapons and 5.5% of them reported carrying a gun at least one day in the month prior to being surveyed (David-Ferdon, 2014). There is evidence that when guns are absent in homes and communities, firearm-related injuries can be reliably and effectively prevented (Dowd, 2012).

A comparison of firearm homicides between U.S. and other high-income countries in the Organization for Economic Cooperation and Development (OECD) showed a higher prevalence in the U.S. than any other of those countries. The U.S. homicide rates were seven times higher than in other high-income countries and that increase was driven by a firearm homicide rate that was 25.2 times higher (Grinshteyn et al., 2016) in the U.S. According to the above source, about 82% of all people killed by firearms are from the U.S. Among those killed by a firearm, 90% of all women, 91% of all children less than 14 years of age and 92% of youths aged 15 to 24 years were from the U.S. This indicates that the burden of weapon-related injuries particularly from firearms was quite high in the U.S. relative to other comparable countries (Grinshteyn et al., 2016).

To the best of our knowledge, no study has examined the association between polysubstance use and weapon-related injuries among high school students in the U.S We hypothesize that use of polysubstance is associated increased odds of weapon-related injuries among high school students.

4.2 Methods

4.2.1. Study Population

The data were obtained from the 2019 Youth Risk Behavior Surveillance System (YRBSS) (n= 13,677, age = 13-19 years), which monitors six categories of priority health-risk behaviors among youths and young adults. These include behaviors that contribute to unintentional injuries, tobacco use, and alcohol and drugs use. The sampling frame for the 2019 national YRBSS consisted of all regular public and private schools with students within the class range of grade 9-12. The sampling was done in all the states and the District of Columbia. It was a three-stage cluster sample design that provided a nationally representative sample of students in grades 9-12 who attended public and private schools (Kann, 2015).

Survey design ensured protection of the privacy of the participants and allowed for voluntary participation. Permission was also sort and obtained from parents. It was a self-administered questionnaire, completed by the students (Kann, 2015). Details of methodology of the national, state, and large urban schools YRBSS can be found elsewhere (Brener et al., 2013)

4.2.2. Questionnaire

Detailed description of the questionnaire used can be found elsewhere (https://www.cdc.gov/healthyyouth/data/yrbs/questionnaires.htm)

4.2.3. Outcome Variable

Weapon-related injuries (yes or no) was used for those who reported being threatened or injured with a weapon on school property. Weapon-related injury was

ascertained with the question “During the past 12 months, how many times has someone threatened or injured you with a weapon such as a gun, knife, or club on school property?” The responses were recoded and summarized as “not injured” (0) for those who were never threatened or injured with a weapon at school and, injured (1) for those who reported one or more injuries caused by a weapon at school.

4.2.4. Exposure Variable

Substance use was defined as having used or not used substances (alcohol, tobacco, select illicit drugs, and marijuana) during the past 30 days. Select illicit drugs include cocaine, inhalants, heroin, methamphetamine, hallucinogens, and ecstasy. Alcohol use was ascertained with the questions “During the past 30 days, on how many days did you have at least one drink of alcohol?”, tobacco use was ascertained with the question, “During the past 30 days, on how many days did you smoke cigarettes?”, while marijuana use was ascertained with the question “During the past 30 days how many times did you use marijuana?”. If a person did not use a substance within the last 30 day, it is coded as “0’ (not used) while any use of a substance either once or multiple times was coded as 1 (used). For select illicit drugs, use of any of the components of “select illicit drugs’ qualifies as “ever use of select illicit drugs”. This includes use of one or more of cocaine, inhalants, heroin, methamphetamine, hallucinogens, and ecstasy. Non-use of any of them, is coded as 0, while use of any of them is coded as 1.

As demonstrated on Table 4.0 below, to determine polysubstance use, the variables were recoded as “not used” where all four substances were 0 (alcohol = 0, select illicit drugs = 0, tobacco = 0 and, marijuana = 0), used alcohol only (alcohol = 1, tobacco = 0, select illicit drugs = 0, and, marijuana = 0), used tobacco only (alcohol = 0,

tobacco = 1, select illicit drugs = 0, and, marijuana = 0), used marijuana only (alcohol = 0, tobacco = 0, select illicit drugs = 0, and, marijuana = 1), used select illicit drugs only (alcohol = 0, tobacco = 0, select illicit drugs = 1, and, marijuana = 0), used alcohol and select illicit drugs, (alcohol = 1, select illicit drugs = 1, tobacco = 0 and, marijuana = 0), used alcohol and tobacco (alcohol = 1, select illicit drugs = 0, tobacco = 1, and marijuana = 0), used alcohol and marijuana (alcohol = 1, select illicit drugs = 0, tobacco = 0 and, marijuana = 1), used tobacco and marijuana (alcohol = 0, tobacco = 1 and, marijuana = 1), , tobacco and select illicit drugs, (alcohol = 0, select illicit drugs = 1, tobacco = 1 and, marijuana = 0), , used marijuana and select illicit drugs, (alcohol = 0, select illicit drugs = 1, tobacco = 0 and, marijuana = 1), and, used three or more

substances : tobacco+ marijuana + select illicit drugs (tobacco = 1, marijuana = 1, and select illicit drugs), tobacco+ marijuana + alcohol (tobacco = 1 and, marijuana = 1 alcohol = 1), tobacco+ alcohol + select illicit drugs (tobacco = 1, alcohol = 1, and, select illicit drugs = 1), alcohol + marijuana + select illicit drugs (alcohol = 1, marijuana = 1 and select illicit drugs = 1), alcohol + tobacco + marijuana + select illicit drugs (alcohol = 1, tobacco = 1 marijuana = 1, and select illicit drugs = 1).

Finally, we combined the substance use variables to form the polysubstance use variable where adolescents who did not use any substance were coded as “No substance used”, all single substance use was coded as “mono-substance used”, all combination of two substances was coded as dual-substance used, while three or more substances use was coded as polysubstance used. The “single substance use” was the reference category in our study because we wanted to understand how abstinence from

substance use and the use of more than one substance (two or more) compared to the use of just one substance.

Table 4.1

Coding of substance use to generate the mono-substance, and polysubstance use variables

Substance used	Alcohol	Marijuana	Tobacco	Select illicit drugs
Used alcohol only	1	0	0	0
Used marijuana only	0	1	0	0
Used tobacco only	0	0	1	0
Used select illicit drugs only	0	0	0	1
Used alcohol and tobacco	1	0	1	0
Used alcohol and marijuana	1	1	0	0
Used tobacco and marijuana	0	1	1	0
Used tobacco and select illicit drugs	0	0	1	1
Used marijuana and select illicit drugs	0	1	0	1
Used alcohol and select illicit drugs	1	0	0	1
Used alcohol, tobacco and select illicit drugs	1	0	1	1
Used alcohol, marijuana and tobacco	1	1	1	0
Used tobacco, marijuana, and select illicit drugs	0	1	1	1
Used alcohol, marijuana, and select illicit drugs	1	1	0	1
Used alcohol, tobacco, marijuana, and select illicit drugs	1	1	1	1

4.2.5. Covariates

Covariates included self-reported sex which was ascertained with the question “What is your sex?” and documented as “male” or “female”. Self-reported race was determined by the question “What is your race?” and documented as White, American Indians, Asians, African Americans, and Native Hawaiians. Ethnicity was determined with the question “Are you Hispanic or Latino?” with responses of “Yes” or “No”. Night sleep duration was assessed with the question “On an average school night, how many hours of sleep do you get?” The responses ranged from less than 4 hours to 10 hours or more. These were recoded as 1 = less than 8 hours and 2 = greater than or equal to 8 hours. The 8 hours cutoff is based on the minimal number of night-time sleep hours recommended by both the National Sleep Foundation and the American Academy of Sleep Medicine. This minimum sleep hours ensures that the adolescent gets adequate sleep to maintain physical and emotional wellbeing as well as maintain school performance (National Sleep Foundation, 2020). Academic grade was assessed by the question “During the past 12 months, how would you describe your grades in school?” This included grades A to F. This was further recoded as 1 = grades A and B, and 2 = grades C to F. The cutoff is based on academic grade B which separates excellent academic performance from less excellent performances Concentration/decision making was assessed by the question “Because of a physical, mental, or emotional problem, do you have serious difficulty concentrating, remembering, or making decisions?”. The response was A = Yes and B= No. This was recoded as 0 = No and 1 = Yes.

4.3. Statistical Analysis

Descriptive analyses were used to examine the demographic characteristics and the prevalence of weapon-related injuries in the sample of high school students. Bivariate analysis was used to determine the association of weapon-related injuries and polysubstance use. Multiple logistic regression analyses were used to examine the association between polysubstance use and weapon-related injuries after adjustment for age, sex, race, ethnicity, night sleep duration, academic grade and, concentration/decision making. One model demonstrated the relationships between weapon-related injuries and each of alcohol, tobacco, select illicit drugs, and marijuana use while “not used” (alcohol = 0, tobacco = 0, select illicit drugs = 0 and, marijuana = 0) was the reference level. A second model demonstrated the relationships between weapon-related injuries and different combinations of any two of alcohol, tobacco, select illicit drugs, and marijuana use while “not used” (alcohol = 0, tobacco = 0, select illicit drugs = 0 and, marijuana = 0) was also the reference level. A third model examined the relationship between polysubstance use and weapon-related injuries by creating four levels of substance use: no substance use, single substance use, dual substance use and multi-substance use. The multi-substance use included any combination of three or more substances. Polysubstance use included both dual substance use and multi-substance use. The other three levels were compared to single substance use. All the analyses were performed using the Statistical Analysis System (SAS) software package version 9.4 (SAS Institute Inc., Cary, NC, USA).

4.4. Results

4.4.1. Social-demographic Characteristics of the Study Population

The study population consisted of adolescents aged 13-19 years (n= 13,677). The proportion of the study sample were 51% males and 49 % females with 37% aged 17 years and older and the other 63% aged younger than 17 years. Sixty one percent of the population were Whites, 13 % were Blacks while 15% consisted of the other racial groups combined. Those from the Hispanic ethnicity were 25% while non-Hispanics were 75%.

Table 4.2

Sociodemographic Characteristics of the Study Population

	Had weapon-related Injuries **N (%)**	**No weapon-related Injuries** **N (%)**	**χ^2**	**P value**
Sex	430 (44.0)	6,180 (49.7)		
Female	547 (56.0)	6,250 (51.3)	11.7	0.0220
Male				
Race				
Whites	583(62.2)	7,678 (68.4)		
Blacks	165 (17.6)	1,666 (14.8)	36.5	0.0053
Others	189 (20.2)	1,878 (16.7)		
Ethnicity				
Non-Hispanic	731 (75.5)	9,113 (74.1)		
Hispanic	237 (24.5)	3,193 (25.9)	0.99	0.5325
Sleep duration				
< 8 Hours	791 (84.2)	9,348 (77.4)		<0.0001
≥ 8 Hours	148 (15.8)	2,729 (22.6)	23.9	
Academic grade				
Grades A&B	564 (60.6)	9,157 (76.4)		<0.001
Grades E to F	366 (39.4)	2,828 (24.6)	114.7	
Problems with Concentration				
No	317 (42.0)	6,114 (63.6)	112.7	<0.0001
Yes	438 (58.0)	3,496 (33.7)		

Only about 22 percent of the study population had 8 or more hours of night sleep, about 75 percent had academic grades of A or B and thirty eight percent reported problems with concentration. In this study population, the prevalence of weapon-related injuries was reported to be 7.4%.

Among adolescents who sustained weapon-related injuries, 56% were males, 62% were Whites, 17.6% were Blacks, and 24.5% were Hispanics. About 15% of adolescents who sustained weapon-related injuries reported adequate night sleep duration, 76% had excellent academic performance and 34% reported problems with concentration and memory.

4.4.2. Weapon-related Injuries among Adolescents Who Used Mono substance

Among the adolescents in the study, the prevalence of alcohol use was 29%, about 22% of the study population currently used marijuana, 37% currently used tobacco while the prevalence of select illicit drugs was 15%. In the unadjusted/bivariate relationship (Table 4.3), participants who used alcohol (OR = 2.63, 95% CI = 2.21 – 3.12, p <0.0001) and those who used marijuana (OR = 2.58, 95%CI = 2.18 – 3.17, p <0.0001) were each more likely to be injured with weapons than those who used no substance.

Individuals who used tobacco were 3.3 times (OR= 3.28, 95% CI = 2.71 – 3.96, p <0.0001) more likely to be injured with weapons while participants who used select illicit drugs were 5 times (OR= 4.95, 95% CI = 3.74 – 6.57, p <0.0001) more likely to be injured than those who do not use any of the substances.

Table 4.3:

Bivariate and Multivariable Association between Mono-substance Use and Weapon-related Injuries among United States Adolescents

	Weapon-related Injuries			
Variables	**Crude OR (95% CI)**	**P value**	**Adjusted OR (95% CI)**	**p value**
Use of Alcohol				
No	2.63 (2.21 – 3.12)	<0.0001	1.34 (1.03 – 1.74)	0.0279
Yes				
Use of Marijuana				
No				
Yes	2.58 (2.18 – 3.17)	<0.0001	1.25 (0.89 – 1.75)	0.1940
Use of Tobacco				
No				
Yes	3.28 (2.71 - 3.96)	<0.0001	1.79 (1.44 – 2.23)	<0.0001
Use of select illicit drugs				
No				
Yes	4.95 (3.74 – 6.57)	<0.0001	2.49 (1.74 – 3.56)	<0.0001

Footnote: the odds ratios (OR), confidence intervals (CI), and p values for the sociodemographic variables for this table are similar to those found in table 4.5. For this reason, duplication of the values for the sociodemographic variables have been omitted for this table.

After adjusting for possible confounding variables, alcohol users were 1.3 times (OR = 1.34, 95% CI = 1.03 – 1.74, p = 0.0279) more likely to be injured with weapons, tobacco users were 1.8 times (OR = 1.79, 95% CI = 2.58 – 3.17, p <0.0001) more likely to be injured than those who did not use any substance and users of select illicit drugs were 2.5 times (OR = 2.49, 95% CI = 2.58 – 3.17, p <0.0001) more likely to be injured with weapons than participants who did not use any substance at all. There was no significant relationship between marijuana users and weapon-related injuries (Table 4.3).

4.4.3. Weapon-related Injuries among Adolescents Who Used Dual substance

Table 4.4 shows that among the study population, the prevalence of dual alcohol and tobacco use was 11%, the prevalence of dual alcohol and marijuana use was 2%, the prevalence of dual tobacco and marijuana use was 5.1%, the prevalence of dual tobacco and select illicit drugs use was 1.3%.

Table 4.4

Bivariate and Multivariable Association between Dual Substance Use and Weapon-related Injuries among Adolescents

Variables	Crude OR (95% CI)	p value	Adjusted OR (95% CI)	p value
Combined use of Alcohol & Tobacco				
No	2.23 (1.39 – 3.62)	0.1582	2.14 (1.37 – 3.21)	0.0069
Yes				
Combined use of Alcohol & Marijuana				
No				
Yes	0.61 (0.18 – 2.31)	0.1242	0.44 (0.19 – 0.92)	0.0013
Combined use of Tobacco & Marijuana				
No				
Yes	3.02 (1.87 – 4.83)	0.0090	2.70 (1.70 – 4.43)	0.0017
Combined use of Tobacco & Select Illicit drugs				
No				
Yes	2.63 (0.96 – 7.24)	0.2775	2.58 (0.83 – 8.05)	0.2539
Combined use of Marijuana & Select Illicit drugs				
No				
Yes	0.94 (0.10 – 7.67)	0.5761	0.72 (0.08 – 6.91)	0.5379
Combined use of Alcohol & Select Illicit drugs				
No				
Yes	1.83 (0.64 – 5.04)	0.7170	1.78 (0.68 – 4.74)	0.5037

Footnote: the odds ratios (OR), confidence intervals (CI), and p values for the sociodemographic variables for this table are similar to those found in table 4.5. For this reason, duplication of the values for the sociodemographic variables have been omitted for this table.

In the unadjusted/bivariate relationship, adolescents who used both tobacco and marijuana were 3 times (OR = 3.02, 95% CI = (1.87 – 4.83), p <0.0090) more likely to be injured with weapons than those who did not use any substance. There was no other significant bivariate relationship between dual substances use and weapon-related injuries.

However, after adjusting for confounding variables, adolescents who combined the use of alcohol and tobacco were about 2 times (OR 95% CI = 1.37 – 3.21, p <0.0069) more likely than adolescents who used no substance to sustain weapon-related injuries. Also, those who combined the use of tobacco and marijuana were 2.7 times (OR = 2.70, 95% CI = 1.70 – 4.43, p <0.0017) more likely to be injured with weapons than adolescents who do not use any substance at all. Dual use of alcohol and marijuana was associated with about 60% decreased likelihood (OR = 0.44, 95% CI = 0.19 – 0.92, p <0.0013) of being injured than those who do not use any substances.

4.4.4. Weapon-related Injuries among Adolescents Who Used Polysubstance

Among the study population, about 2.9% of the adolescents used a combination of all four substance groups. From table 4.5, participants who engaged in multi substance use were 2.3 times (OR = 2.34, 95% CI = 1.57 – 3.46, p <0.0001) more likely to be injured with a weapon than those who used only a single substance, while those who did not use any substance at all were 50% less likely (OR = 0.45, 95% CI = 0.29 – 0.69, p <0.0001) to sustain weapon-related injuries compared to those who used a single substance. In terms of their association with weapon-related injuries, adolescents who used dual substances were not significantly different than those who used mono substances.

Table 4.5

Bivariate and Multivariable Association between Polysubstance Use and Weapon-related Injuries among Adolescents

	Weapon-related Injuries			
Variables	**Crude OR (95% CI)**	**p value**	**Adjusted OR**	**p value**
Sex				
Female				
Male	1.26 (1.03 – 1.54)	0.0288	1.41 (1.09 – 1.80)	0.0085
Race				
Whites (Ref)				
Blacks	1.31 (0.99 – 1.74	0.2208	1.10 (0.69 – 1.62)	0.4959
Others	1.32 (0.93 – 1.89)	0.2016	1.23 (0.82 – 1.85)	0.3870
Ethnicity				
Non-Hispanic				
Hispanic	0.93 (0.72 – 1.19)	0.5383	0.93 (0.63 – 1.33)	0.6302
Sleep duration				
< 8 Hours				
≥ 8 Hours	0.64 (0.52 – 0.78)	<0.0001	0.80 (0.62 – 1.04)	0.0927
Academic grad				
Grades A&B				
Grades E to F	0.48 (0.39 – 0.57)	<0.0001	0.66 (0.51 – 0.85)	0.0023
Problems with Concentration				
No				
Yes	2.41 (1.89 – 3.07)	<0.0001	2.14 (1.68 – 2.71)	<0.0001
Polysubstance Use				
Single substance use				
No substances use	0.45 (0.29 – 0.69)	<0.0001	0.47 (0.29 – 0.75)	<0.0001
Dual substance use	1.02 (0.64 – 1.62)	0.9946	0.99 (0.64 – 1.52)	0.7275
Polysubstance use	2.34 (1.57 – 3.46)	<0.0001	1.78 (1.18 – 2.68)	<0.0001

After adjusting for possible confounders there was no significant association between dual substance use and weapon-related injuries when considering single substance use as the reference. Adolescents who did not use substances were 50%

less likely (OR = 0.47, 95% CI = 0.29 – 0.75, p <0.0001) to sustain weapon-related injuries while those who used multi substances were 1.8 times (OR = 1.78, 95% CI = 1.18 – 2.68, p <0.0001) more likely to sustain weapon-related injuries compared to those who used only a single substance.

4.5. Discussion

There have been previous studies that considered the prevalence of injuries among students within the school environment. According to one study (Wadhan et al., 2016), the overall prevalence of injuries in schools was considerably high reaching up to 68.5%. The study did not report on weapon-related injuries which is a contrast from our study in which we reported a 7.4% prevalence of weapon-related injuries among adolescents in our study population. This correlates well with the growing public health concerns of premature deaths and unnecessary disabilities associated with weapon-related injuries among adolescents (Fowler et al., 2017).

The study population consisted of an even distribution of the males and females, indicating a nearly equal representation by sex and thereby promotes the finding that the association of substance use and sustaining of injuries among adolescents was similar for both sexes (Peltzer, 2017). Previous studies have shown that weapon carrying was more prevalent among the White adolescent group, and although our study did not consider weapon-carrying, it indicates that a greater proportion of the study population and a higher percentage of those who sustained weapon related injuries were Whites. We examined the prevalence of adequate sleep duration in the adolescent population group and the results show that only 22 percent of our study participants reported eight or more hours of sleep. Despite a majority having less than

eight hours of sleep per night, a greater proportion of the population obtained academic grades A and B. This correlation between low sleep duration and academic excellence may not be intuitively expected and may provide an avenue for future research. About 38% of our study population reported problems with concentration/memory despite more than 70% obtaining excellent academic grades. Although the timing of the poor concentration relative to the use of substances was not reported, it appears to be deserving of further evaluation and research to determine if the poor concentration and memory problems were closely related to the timing of substance use.

The prevalence of adolescents who used substances within our study population were relatively lower compared to previous studies. For example, while one study (Johnson et al, 2014) found a 67 % prevalence of alcohol use among 12th graders, a 50% prevalence of marijuana among 9th to 12th graders and a 40% prevalence of tobacco use among 9th to12th graders, our study reported only a 29% prevalence of alcohol use, 22% prevalence of marijuana and 37% prevalence of tobacco use. The use of a differing study populations than the other studies and the self-reported nature of our studies with some adolescents probably unwilling to report their alcohol, marijuana, and tobacco use, may explain some of these differences in prevalence. Our study however showed similarity in the prevalence of select illicit drugs use compared to previous research.

Regarding the dual use of substances, dual alcohol and tobacco use showed the highest prevalence at 11% while the prevalence of dual tobacco and select illicit drugs use was 1.3%. The prevalence of other dual combination of substances ranged between those two numbers. The dual alcohol and tobacco use showing the highest

proportion is consistent with reports from the Centers for Disease Control and Prevention which indicates that alcohol and tobacco are the two substances mostly used by adolescents in the United States (CDC, 2018). Use of three or more substances show prevalence of between 2.9% for the use of all substances and 10.7% for the use of a combination of alcohol, marijuana, and tobacco. These percentages are consistent with the findings that adolescents who use one substance are likely to use other substances (Sampasa-Kanyinga, 2018).

Evidence from our study suggest that significant associations exist between substance use and weapon-related injuries among adolescents. Users of alcohol were about two and half times more likely to sustain weapon-related injuries. This relationship was replicated for the association between marijuana users and weapon-related injuries and slightly higher for the relationship with each of tobacco use and select illicit drugs use. These findings persist even after adjusting for confounders and corroborates well with previous research that show association between substance use and having sustained 2 or more injuries within the 12 months of the study (Peltzer, 2017). It also emphasizes that self-reported injuries are more likely among alcohol users, particularly those who are younger than 25 years of age (Coomber et al., 2017).

Our study showed that adolescents who used dual alcohol and tobacco were twice as likely to be injured with weapons than their counterparts who do not use any substance at all while those who use tobacco and marijuana were 2.7 times more likely to be injured with a weapon. This finding suggests a corroboration of previous research indicating that substance use is associated with significant risks to personal safety. The association of dual use of alcohol and marijuana with weapon-related injuries shows

lower odds of weapon-related injuries and may require further investigation to understand the nature and extent of this relationship.

Our study shows that adolescents who did not use any substance have lower odds of weapon-related injuries compared to those who use a single substance. Those who used three or more substances had higher odds of sustaining weapon-related injuries compared to those who used only one substance. There was no significant difference in the odds of weapon-related injuries for adolescents who used two substances compared to those who used only one. To the best of our knowledge there is currently no research reporting similar relationships between polysubstance use and weapon-related injuries. The scarcity of research portraying the relationship between polysubstance use and weapon-related injuries provides unique opportunities for further research to guide the development of strategies for the prevention of both the initiation of substance use and addition of more substance types by adolescent who currently use substances.

Notably, our study is not able to determine the temporal relationship between polysubstance use and weapon-related injuries because of the cross-sectional nature of the study. Information bias could also be a problem owing to the self-reported nature of the survey. The study however has public health implications. For instance, public health efforts need to focus on prevention of substance use initiation because it provides the greatest benefits. Also, for adolescents on multiple substances, removal of one substance provides immense benefits and reduces the odds of weapon-related injuries. Therefore, treatment for polysubstance use can be pursued one substance at a

time bearing in mind that the lesser the number of different substances used, the less likely the odds of weapon-related injuries.

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Chapter 5. Conclusion

Using data from two major sources, we examined the association of adolescent polysubstance use with adolescent dating violence, adolescent criminal arrests, and weapon-related injuries. The relationships between adolescent polysubstance use and adolescent dating violence as well as the association between adolescent polysubstance use and weapon-related injuries were examined using data from the 2019 Youth Risk Behavior Surveillance System (YRBSS, 2019). The association between adolescent polysubstance use and adolescent criminal arrests was investigated using data from the 2018 Treatment Episode Data Set- Admission (TEDS-A, 2018). The study examined the association between the response variables and graduated use of substances, from the use of single substance like each of alcohol and marijuana, to dual substances like using both alcohol and marijuana and then to the use of 3 or more substances. The graduated substance use format in this study was unique but important because it provided us the opportunity to understand how the use of a combination of substances was associated with adolescent dating violence, adolescent criminal arrests, and weapon-related injuries.

Our study found the prevalence of physical dating violence to be 8.2%. This percentage was same for sexual dating violence but different for a combination of physical and sexual dating violence which was 2.9%. These prevalence rates were lower than reported in the previous literatures (Haynie et al., 2013, Silverman et al., 2001) and may have resulted from the use of self-reported surveys in our study.

Adolescents who did not use any substance were 50% less likely to experience physical dating violence, 40% less likely to experience sexual dating violence, and 50%

less likely to experience combination of both physical and sexual dating violence compared to those who used single substances. Compared to adolescents who used single substances, adolescents who used polysubstance were about 2 times more likely to experience physical dating violence, 2 times more likely to experience sexual dating violence and 2.8 times more likely to have experienced both sexual and physical dating violence.

The above shows that abstinence from substance use is more beneficial in terms of the odds of dating violence compared to the use of even a single substance. Also use of polysubstance increases the odds of dating violence and efforts should be made to discourage the use of additional substances by adolescents. This knowledge creates an opportunity for program planners to pay attention to adolescents who used polysubstance and to understand that scaling down the number of substances used by adolescents, one substance at a time may be beneficial in reducing the impacts of polysubstance use on public health.

In the study of the association between adolescent polysubstance use and adolescent criminal arrests, the overall prevalence of adolescent criminal arrests was 17.2%. About 14.3% had been arrested once while 2.8% had been arrested two or more times. Among those who had been arrested at least twice, 21% used select illicit drugs, 4.4% combined select illicit drugs with alcohol, 60% combined select illicit drugs with marijuana, and 14% combined all three substances.

Adolescents who used multiple substances had increased odds of being arrested. Among adolescents who used polysubstance, Blacks were 30% less likely to be arrested than their White counterparts, and males were 1.4 times more likely to be

arrested than females. Adolescents who used both select illicit drugs and alcohol were 1.7 times more likely to be arrested and adolescents who used both select illicit drug and marijuana were 1.5 times more likely to be arrested than those who used only select illicit drugs. Adolescents who used all three substances (polysubstance) were 1.6 times more likely to be arrested than those who used select illicit drugs only.

Finally, our study found a 7.4% prevalence of weapon-related injuries among adolescents. The prevalence of dual alcohol and tobacco use was 11%, and the prevalence of dual alcohol and marijuana use was 5.1%. Adolescents who used both alcohol and tobacco were 2 times more likely and those who used both tobacco and marijuana were 2.7 times more likely to sustain weapon-related injuries. On the other hand, those who used both alcohol and marijuana as well as adolescents who used alcohol and tobacco were less likely to sustain weapon-related injuries than those who did not use any substance at all. This association is notable and deserves further studies to unravel why combined alcohol and marijuana use is protective for weapon-related injuries. Adolescents who used polysubstance were 1.8 times more likely to sustain weapon-related injuries while adolescents who did not use any substance were 50% less likely to sustained weapon-related injuries compared to those who used single substances. These findings show that abstinence from substance use may be associated with less odds of injuries while polysubstance use increases the odd of weapon-related injuries.

To the best of our knowledge, this study is the first to investigate the effect of graded combinations of substances (from 1 substance to 4 different substances) on adolescent dating violence, criminal arrests, and weapon-related injuries. We used large

sample sizes, that were representative of the U.S. adolescent population. Our study however cannot establish causality between polysubstance use and the response variables because it is a cross-sectional study. There is also the challenge of information bias associated with self-reported surveys especially among adolescents who used substances. Since the data is secondary, we had no control over the accuracy of data collection. The findings of our study must be interpreted bearing these limitations in mind.

In summary, our study found significant associations between polysubstance use and physical, sexual, and combined physical and sexual dating violence. There was also a significant association between polysubstance use and adolescent criminal arrests as well as significant associations between polysubstance use and weapon-related injury among U.S. adolescents. Findings from this study could be beneficial in planning programs that aim to prevent dating violence, and weapon-related injuries through efforts to decrease polysubstance use among adolescents. Understanding the relationship between polysubstance use and adolescent criminal arrests is also relevant to reducing the high rates of adolescent criminal arrests and incarcerations in the U.S.

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