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The Association Between Illicit Drug Use and Suicide Attempts Among Adolescents: Electronic Bullying as an Effect Modifier

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ABSTRACT

THE ASSOCIATION BETWEEN ILLICIT DRUG USE AND SUICIDE ATTEMPTS AMONG ADOLESCENTS: ELECTRONIC BULLYING AS AN EFFECT MODIFIER

By

ALEXANDRIA DANAE BLAKE

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INTRODUCTION: The World Health Organization (WHO) defines adolescence as "the period in human growth and development that occurs after childhood and before adulthood, from ages 10 to 19" (Adolescent Development). The National Institute on Drug Abuse (NIDA) reports that people are most likely to begin abusing drugs during adolescence and young adulthood and adolescents who use drugs often have mental health issues (Principles of Adolescent Substance Use Disorder Treatment: A Research-Based Guide, n.d.). Cyber bullying is defined as "using technology, like cell phones and the Internet, to bully or harass another person", and can include anything from sending mean messages or threats through email, spreading rumors through texts, posting harmful messages on social media, sexting, and many other acts (Cyber Bullying Statistics, 2015). Although multiple studies have shown an association between substance use and suicide, the affect electronic bullying has on this relationship has not been examined. This study will attempt to find an answer to the research questions "What is the relationship between illicit substance use (specifically alcohol, heroin, methamphetamines, and prescription drugs) and suicide among adolescents?" and "How does electronic bullying affect the relationship between illicit substance use and suicide among adolescents?".

METHODS: This study used data from the Centers for Disease Control and Prevention's (CDC) 2015 National Youth Risk Behavior Surveillance Survey (YRBS). The 2015 YRBS survey included questionnaires from 125 schools and 15, 624 student surveys. SAS 9.4 software was used for analysis of demographic variables, bivariate logistic regression, and multivariable logistic regression. Odds ratios, p-values (α=0.05), and 95% Confidence Intervals were reported.

RESULTS: Analysis showed that White male students who were 17 years old had the highest proportions of engaging in using and abusing heroin, alcohol, methamphetamines, and/or prescription drugs. Among those students who were victims of electronic bullying and those who attempted suicide in the past 12 months, 15-year-old White female students had the highest

proportions. Substance use showed an association with students attempting suicide, and heroin and meth use were associated with the highest increased odds. There was also a change in the associations of substance use and attempting suicide in those students who were electronically bullied. Combining the effect of substance use and electronic bullying does show a change in the association between using drugs and attempting suicide.

CONCLUSION: The findings of this study show that in adolescents there are separate associations between: 1) engaging in substance and attempting suicide and 2) being a victim of electronic bullying and attempting suicide. This study also found that there is an association with suicide attempts in those students who are both engaging in substance use and who are victims of electronic bullying, suggesting that electronic bullying is acting as an effect modifier on this association.

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Author's Statement Page

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CHAPTER I - INTRODUCTION

Background

The World Health Organization (WHO) defines adolescence as "the period in human growth and development that occurs after childhood and before adulthood, from ages 10 to 19" (Adolescent Development). Adolescence is marked by physical changes, mental maturation, and increased pressure from peers to engage in risky behaviors like drinking alcohol, using cigarettes and other drugs, or entering unsafe sexual relationships (Ammerman, Steinberg, McCloskey, 2016). The National Institute on Drug Abuse (NIDA) reports that people are most likely to begin abusing drugs during adolescence and young adulthood and adolescents who use drugs often have mental health issues such as substance use disorders, depression, anxiety, and suicidal thoughts (Principles of Adolescent Substance Use Disorder Treatment: A Research-Based Guide, n.d.). Data from the Centers for Disease Control and Prevention's (CDC) National Violent Death Reporting System shows that out of those who committed suicide in 2010, 33.4% had alcohol in their system, 23.8% had antidepressants, and 20.0% had taken opiates, including heroin and prescription pain killers (Suicide Facts at a Glance, 2015). While females are more likely than males to have suicidal thoughts, males are more likely to commit suicide. In 2015, 1,788 males aged 10-19 committed suicide compared to 682 females; this is a ratio of almost 3 to 1 (Centers for Disease Control, 2015)

Although drug use is an ever-present issue today, the rates of drug use and the types of drugs being used are changing. According to the 2016 United Nations Office on Drugs and Crime report, worldwide drug use has been steady but heroin use in the United States was up 145% since 2007 (World Drug Report, 2016). Along with the rise in heroin use in the United States, the number of deaths from heroin has increased as well. The UN Report found that "deaths related

to heroin have increased fivefold since 2000", and overdose deaths make up half of all drug-related deaths (World Drug Report, 2016). Teens now often turn to heroin use because they are increasingly being prescribed legal anti-depressants, opioid painkillers, and prescription stimulants, all of which act as "gateway drugs" to harder substances (Why Suburban Teens Are Most at Risk for Heroin Use, n.d.). Teens trying to get high begin abusing alcohol or taking prescriptions and as they build up a tolerance to these substances, they eventually cannot reach the same high and need something stronger; this is when teens turn to heroin (Why Suburban Teens Are Most at Risk for Heroin Use, n.d.). Long-term effects of heroin can include decreased oxygen to the brain and altered physical structures in the brain. When the physical structures of the brain are altered, mental health issues can arise such as depression with inability to feel happiness and social isolation which can contribute to suicidal thoughts and attempts (The Effects of Heroin Use, 2015).

Another dangerous drug that adolescents turn to is methamphetamine (meth). Meth is an addictive stimulant drug that causes release of the neurotransmitter dopamine in the brain (Methamphetamine (Meth), n.d.). Dopamine release leads to feelings of extreme pleasure but over time it can cause chemical and molecular changes in the brain (Methamphetamine (Meth), n.d.). In 2015, the Idaho Meth Project released results from its Statewide Meth Use & Attitudes survey. The survey reported that 34% of Idaho teens believe meth will help them lose weight, 28% believe meth makes you feel happy, and 14% believe meth helps you escape personal problems (Idaho Meth Project, n.d.) These statistics are alarming because they show that many teens do not know about or either choose to ignore the negative consequences of using meth.

Prescription drug abuse can be defined as "the intentional self-administration of a medication for a nonmedical purpose such as 'getting high'" (Prescription Drug Abuse Statistics, n.d.).

Abuse of prescription drugs is a growing problem for adolescents; after marijuana and alcohol they are the most commonly misused substance by Americans 14 and older (Prescription Drugs, n.d.). Prescription drugs can include depressants like Xanax, stimulants like Adderall, and opioids like Oxycontin. The main way prescription drugs are misused are by taking someone else's medication, taking a medication in a way other than how it is prescribed, taking a prescription medication to get high, or mixing it with other drugs (Prescription Drugs, n.d.). In the 2010 Monitoring the Future survey, more than half of the 12th graders surveyed said they were given the drugs or bought them from a friend or relative. The youth who abuse prescription drugs are also more prone to use other drugs such as cigarettes, alcohol, marijuana, and cocaine (Adolescents and young adults, n.d.). The misuse of prescription drugs often leads to overdoses and this misuse accounts more than half of the drug overdose deaths in the US.

Finally, electronic bullying (also known as cyber bullying) has recently become a major issue for adolescents. Cyber bullying is defined as "using technology, like cell phones and the Internet, to bully or harass another person", and can include anything from sending mean messages or threats through email, spreading rumors through texts, posting harmful messages on social media, sexting, and many other acts (Cyber Bullying Statistics, 2015). Since teens are going through such a crucial period in mental development, cyber bullying can lead to or exacerbate already present behavior health issues like anxiety, depression, and suicide (Cyber Bullying Statistics, 2015). Statistics from the DoSomething.org global organization state that nearly 43% of kids have been bullied online, girls are about twice as likely as boys to be both victims and perpetrators of cyber bullying, and victims of bullying are 2 to 9 times more likely to consider committing suicide (11 Facts About Cyber Bullying, n.d.).

Research Questions and Aims

Although multiple studies have shown an association between substance use and suicide in both adults and adolescents, the modification electronic bullying has on this relationship specifically in adolescents has not been examined. This study aims to measure the relationship between illicit substance use (specifically alcohol, heroin, methamphetamines, and prescription drugs) and suicide among adolescents and to measure if and/or how electronic bullying modifies the relationship between illicit substance use and suicide among adolescents. These drugs were examined because alcohol use among teens is a constant issue and addictions to heroin, methamphetamine, and prescription drugs are often in discussed in today's media. The hypotheses are: 1) students who use illicit drugs will be at increased odds of attempting suicide than those students who do not use drugs, and 2) students who are electronically bullied and use drugs will also be at increased odds of attempting suicide than those students who do not use drugs and are not electronically bullied.

CHAPTER II – LITERATURE REVIEW

Adolescent Suicide

According to the CDC, in 2014 suicide was the 2nd leading cause of death for youth ages 10-14 and ages 15-24 with 5,504 reported suicides in these two age groups combined. (Centers for Disease Control and Prevention, 2014). However, within these two groups, suicide rates do differ by gender and among race/ethnic backgrounds. The suicide rate is highest among American Indian/Alaska Native males while it is lowest in Black females, and youth who are a sexual minority (LGBTQ+) have a rate of suicidal ideation twice that of youth not in this category (Shain, B. and AAP Committee on Adolescence, 2016). Adolescent suicide can also be

heavily influenced by many risk factors; for example, being adopted, mental health issues, sexuality, being abused, being bullied, etc (Shain, B. and AAP Committee on Adolescence, 2016). While adolescent suicide is often influenced by things out of their control, there are other risks that teens choose to take that can also have influences. A major adolescent developmental behavior is risk taking; teens are more likely to use tobacco, alcohol and other drugs, to have unprotected sex, or to drive recklessly (Ammerman, Steinberg, McCloskey, 2016). Although the presence of these associations has been studied, their directionality on suicide still has not been established. It is unclear if adolescents take risks because they are suicidal or if being suicidal causes them to take unnecessary risks.

Adolescent Substance Use

Adolescence is a period of development marked by increased risk-taking and experimentation; using drugs and drinking alcohol are two of these such behaviors that emerge during this time (Ammerman, Steinberg, McCloskey, 2016). Most national statistics and cross-sectional studies show that mean levels of substance use are higher in males than females, but longitudinal studies show that girls begin substance use earlier than boys while boys have a higher usage later in adolescence (Chen & Jacobson, 2012). Although the rates at which teens use drugs and drink alcohol may vary, adolescent substance use and abuse is still a major public health concern. In the 2015 National Survey on Drug Use and Health, approximately 2.2 million adolescents aged 12 to 17 reported currently using illicit drugs (National Survey of Drug Use and Health, n.d.). Specifically, 28.40% of youth reported using alcohol in their lifetime, 0.10% reported using heroin, 0.30% reported using methamphetamine, and 25.30% reported using some type of illicit drug.

Alcohol is the substance of choice for most adolescents; however, the trends in how alcohol is consumed among this age group change from generation to generation. In 2012, national data from the Monitoring the Future studies showed historic lows in the self-reported prevalence of alcohol use in 8th, 10th, and 12th graders (Windle, M., 2016). Dr. Windle's article, "Drinking Over the Lifespan: Focus on Early Adolescents and Youth", also reported that drinking and driving traffic fatalities involving 16 to 20 years old decreased from 66% of traffic fatalities in 1982 to 37% of traffic fatalities in 2010 (Windle, M., 2016). Despite a decrease in overall prevalence rates of alcohol use in adolescents, teens still have high rates of binge drinking (having 5 or more drinks in a row in the past two weeks). Almost one-fourth of 12th graders and almost one-half of 10th graders reported binge drinking, and even almost one-fourth of 8th graders reported drinking at some point in the past year (Windle, M., 2016). Drinking in adolescence is dangerous by itself; however, it also often leads to engaging in other risky behaviors such as co-occurring illicit substance use, unprotected sex, lower school performance, traffic accidents, and suicide. Alcohol's impact on teens is not felt only in the United States but was the main risk factor for disability-adjusted life-years (DALY's) in ages youth 10-24 worldwide in 2011 (Windle, M., 2016). Although overall alcohol prevalence in adolescents is decreasing, it remains a major concern.

Substance Use and Suicide

The Youth Behavior Surveillance Survey is used to study a variety of behaviors among adolescents. One study used data from the YRBS to attempt to better understand the substance abuse and suicide in adolescents (Wong, et al, 2013). Although they were clear on the fact that there is an association between these two behaviors, they sought to examine how the association changes depending on both the type and number of substances used. The survey included 73,183

students from 2001 to 2009 that was weighted to be nationally representative by gender, grade, and ethnicity. Wong and associates used twenty-seven measures from the survey, categorized into measures of suicide thoughts and behaviors (suicide ideation, suicide plans, suicide attempts, severe suicide attempts requiring medical attention), measures of lifetime substance use (alcohol, tobacco, marijuana, cocaine, ecstasy, heroin, hallucinogens, inhalants, methamphetamines, steroids), socio-demographic variables (age, gender, ethnicity, grade), interpersonal violence (partner violence, forced sexual intercourse, physical fights, school violence, unsafe feelings), and other known risk factors for suicidality (depressive symptoms, restrictive and purging symptoms of eating disorders, sexual intercourse) (Wong, et al, 2013). By using univariate analysis and multiple logistic regression analyses the researchers found that adolescents who had used heroin at least once had the highest univariate odds of reporting suicide ideation, suicide planning, suicide attempts, and severe suicide attempts; methamphetamines had the second highest odds. In the multivariate analysis that controlled for confounders students with at least one lifetime use of heroin again had the strongest odds ratio for suicide, but hallucinogens were the second highest. Finally, in the analysis that compared using multiple substances with suicide the association increased as the number of substances increased, for example those adolescents who had a lifetime use of ten substances had odds ratios of 3.4, 3.3, 8.5, and 18.8 for suicide ideation, plans, attempts, and severe attempts respectively. They concluded that specific categories of illicit substance use and a higher lifetime total of substance use dramatically increase the risk of adolescent suicidality.

Electronic Bullying

Bullying is an issue that has affected adolescents for decades; however, with rapidly changing technology and the increased presence of social media, cyberbullying has become a new problem

for teens. According to one study conducted in England, "Cyberbullying is defined generally as bullying that occurs online, or more specifically as an 'aggressive, intentional act carried out by a group or individual, using electronic forms of contact, repeatedly and over time against a victim who cannot easily defend him or herself' (Smith, et al, 2008)". The Smith UK study used focus groups with adolescents and anywhere from 67-100% of the students in the various groups admitted to being a victim of cyberbullying, with phone calls and text messages as the most common methods of cyberbullying. This has become a public health issue because many victims of cyberbullying turn to suicide to cope with their problems.

Summary

Adolescents are at a major developmental milestone in their life but this period has become complicated by electronic bullying, access to illicit substances, and the beginnings of suicidal thoughts and actions.

CHAPTER III – METHODS AND PROCEDURES

Youth Risk Behavior Survey

The Centers for Disease Control's (CDC) 2015 Youth Risk Behavior Survey (YRBS) was used to better understand the association between drug use, electronic bullying, and suicide attempts. The YRBS is part of a larger system called the Youth Risk Behavior Surveillance System (YRBSS). The YRBSS began in 1990 as a way to monitor the prevalence of major health risk behaviors that impacted the leading causes of death, disability, and social problems among youth and adults. The YRBS uses a three-stage cluster sample design to create a sample that is representative of 9th through 12th grade students in the United States. Its target population includes all public, Catholic, and other private school students in 9th through 12th grade. The

survey is weighted based on the sex, race/ethnicity, and grade level of each student to adjust for school and student nonresponse and oversampling of Black and Hispanic students. The overall weights were then scaled so that the weighted count of students equaled the total sample size and so that the weighted proportions of students in each grade matched the national population proportions. The survey also used a three-stage cluster sample that was stratified by racial/ethnic concentration and MSA Status. The survey was then further broken down into Primary Sampling Units (PSUs) that consisted of counties, groups of smaller adjacent counties, or sub-areas of large counties. For the analysis "Weight" corresponds with the weight factor assigned to each student record, "Stratum" corresponds with the stratum the school the student attends was assigned to, and "PSU" corresponds with the PSU the school the student attends was assigned to.

Sample Population

The sample for the 2015 YRBS included all regular public, Catholic, and other private school students in grades 9 through 12 in the 50 states and District of Columbia. The survey sampled from one hundred and eighty schools and responses to all questions were self-reported.

Dependent Variable

The dependent variable in this study was "Q29-During the past 12 months, how many times did you actually attempt suicide?". In the YRBS the answers to this question ranged from 0 times to 6 or more times. In the analysis, this variable was recoded and dichotomized so that 0 times equaled "No" and that any response of 1 time or more equaled "Yes".

Independent Variables

Independent variables in this analysis were all related to substance use; the chosen substances for this study were alcohol, heroin, methamphetamines, and prescription drugs. Although the

survey responses for these variables ranged from 0 times to 40 or more times, they were dichotomized to be Yes (1 or more times) or No (0 times) answers for analysis. The variables for substance use were also combined into one composite variable to see how using any substance affects the results.

Covariates

Multiple covariates are used in this analysis, including age, grade, and gender. Ages ranged from 12 years or younger to 18 years or older and also included missing responses, grade ranged from 9^{th} grade to 12^{th} grade, and gender was categorized as Female, Male, or Missing. Race/ethnicity was also used as the combined variable from the YRBS called "Raceeth". The final covariate electronic bullying which was categorized as Yes, No, or Missing.

Variables

The main exposure in this study is illicit drug use and the main outcome is suicide attempt. Electronic bullying is being used as an effect modifier. Confounders include age, grade, and race as they could potentially affect both the exposure and outcome of interest.

Statistical Analysis

Statistical Analysis Software (SAS) 9.4 was used to analyze the data. The YRBS uses a three-stage cluster sampling technique and weights the survey responses, to account for this the SAS procedures PROC SURVEYFREQ and PROC SURVEYLOGISTIC were used. Bivariate analysis was used to determine crude odds ratios between the alcohol and drug use variables and the electronic bullying variables and the variable for suicide attempts. Multivariate logistic regression was used to control for the confounding covariates age, gender, and race. The multivariate logistic regression was also stratified into two groups: those participants who had

not experienced electronic bullying and those who had experienced electronic bullying. The alcohol and drug use variables were recoded into dichotomous variables that had yes and no as responses. To determine statistical significance p-values with $\alpha=0.05$ and 95% Confidence Intervals were used.

CHAPTER IV - RESULTS

The 2015 YRBS had a 69% school response rate as 125 of the sampled schools participated and there was an 86% student response rate as 15,713 of the 18,165 sampled students submitted questionnaires. Taking these numbers into account, the survey had a 60% overall response rate and used 15,624 of the submitted questionnaires.

Table 1 shows that among heroin users, 15-year-old students had the highest proportion of use at 24% while 13-year-old students had the lowest proportion at 1%. 10th grade students had a proportion of almost 28%, followed by students in 11th grade at almost 26%. Male students had a proportion of 73% while females were at 26%. Finally, White students had the highest proportion of heroin use at 34% while American Indian/Alaska Native students had the lowest at only 0.05%. All of the p-values were less than 0.05 which means all the demographic variables showed a statistically significant association with heroin use.

Table 1 also shows that among alcohol users, the highest proportions are found in those students who are white, male, 17-years-old, and in the 12th grade. Among alcohol users, 29% were 17-year-old students while only 0.03% were 13-year-old students. 12th grade students made up almost 30% of those who reported alcohol use which was closely followed by 11th grade students at almost 28%. Male students and female students had almost equal proportions of alcohol use, with females at 49% and males at just under 51%. Finally, White students had the

highest proportion of alcohol use at almost 59% compared to Native Hawaiian/other Pacific Islander students who only made up 0.75% of those students who use alcohol. For alcohol use, all of the p-values showed statistically significant associations except for gender which had a p-value of 0.1292.

Finally, Table 1 shows that students who are White, male, and 18-years old have the highest proportions of methamphetamine use. Among meth users, 10th grade students made up the largest proportion which unlike the other drugs, does not correspond with the highest-ranking age group. In those students who used meth, 29% were 18-year-olds while 31% were 10th grade students. Male students had a proportion of meth use at 66% which is twice that of females at 34%. Finally, White students made up 35% of those students who used meth while American Indian/Alaska Native students made up the smallest proportion at only 0.51%. All of the p-values for meth use were statistically significant as they were all less than 0.05.

Table 2 shows that among students who use prescription drugs that are not prescribed for them or in a manner different from the way they were prescribed, the highest proportions can be found among students who are White, male, 15 or 16 years old, and in the 12th. As with methamphetamines, the age groups and grade do not correspond; 15-year-old and 16-year-old students had almost equal proportions at 26.76% and 26.09% respectively but 12th grade students made up the largest proportion of prescription drug users at almost 30%. Among those students who used prescription drugs, male students had a proportion of 60% while female students accounted for 40%. Finally, White students had the highest proportion of prescription drug users at 51% compared to the lowest in American Indian/Alaska Native students at less than 1%. All of the p-values for the associations between the variables and prescription drug use were statistically significant because they were less than 0.05.

Table 2 also shows that among students who reporting using at least one of the above substances, the highest proportions around found in students who are male, White, 17 years old, and in the 12th grade. Among those who reported any substance use, 29% were 17-year-old students which corresponds with 19% of users also being in the 12th grade. Males had a slightly higher proportion of substance use at 51% compared to 49% for female students. As with all of the substances separately, when combined White students had the highest proportion at almost 58%. In this analysis, gender was the only variable with a p-value greater than 0.05 which means it was not a statistically significant association.

Table 3 shows that among students who are electronically bullied, the highest proportions are found in students who are 15 years old, in 9th grade, female, and White. Among those who were electronically bullied, 15-year-olds made up 27% which roughly corresponds to 9th grade students also having the highest proportion at just under 29%. Females had a proportion of 68% which is twice the proportion of male students at 32%. Finally, as with all of the other variables, White students had the highest proportion of those who were electronically bullied at 64%. For electronic bullying, all of the variables had p-values less than 0.05 except for grade which had a p-value of 0.2, making it not a statistically significant association.

Table 3 also shows that among students who attempted suicide within the past 12 months, the highest proportions are found in White, female students who are 15 years old and in the 9th grade. Among those who attempted suicide within the past 12 months, 15-year-old students had the highest proportion at 31% which roughly corresponds with 9th grade students having the highest proportion at almost 32%. 68% of those who attempted suicide were female while 32% were male students. White students had the highest proportion of suicide attempts at 41% while

Native Hawaiian/other Pacific Islander students had the lowest at 0.15%. All p-values were less than 0.05, making all of the associations with suicide attempts statistically significant.

Table 4 displays the crude results of bivariate analyses between each of the substances and electronic bullying by suicide attempt and the results after adjusting for age, gender and race. Those students who used heroin were at 18 times (OR 18.00, 95% CI 12.3, 26.3, p-value <0.0001) increased odds of attempting suicide when compared to students who did not use heroin. The confidence interval for this association is somewhat large which most likely can be attributed to the small sample of students who used heroin. After adjusting for confounders, those students who used heroin had almost 26 times (aOR 25.59, 95% CI 16.6, 39.6) the odds of attempting suicide when compared to students who did not use heroin. The confidence interval for this odds ratio remained large due to the small sample. Using alcohol put students at 3.80 times the odds (OR 3.80, 95% CI 2.4, 6.1, p-value <0.0001) of attempting suicide compared to those students who did not use alcohol. After adjusting for age, race, and gender students who used alcohol had 4 times (aOR 4.29, 95% CI 3.3, 5.6) times the odds of attempting suicide than those students who did not use alcohol. Methamphetamine use was associated with 14.76 times the odds of attempting suicide (OR 14.76, 95% CI 9.7, 22.4, p-value <0.0001) but also had a large confidence interval most likely due to the small sample size. After adjusting for age, gender, and race the odds of attempting suicide in those who used meth increased to 15 times (aOR 15.34, 95% CI 10.6, 22.3) the odds of students who did not use meth. Students who used prescription drugs had 4.6 times the odds (OR 4.60, 95% CI 3.8, 5.6, p-value<0.0001) of attempting suicide than those students who did not use prescription drugs. After adjusting for confounders, students who had ever used prescription drugs had 10 times (aOR 10.45, 95% CI 8.8, 12.5) the odds of attempting suicide than those students with no prescription drug use. After

combining the substances into one variable to address drug use, those students who used any substance were at almost 3 times (OR 2.71, 95% CI 2.3, 3.3, p-value <0.0001) the odds of attempting suicide when compared to those students who did not use any substance. After adjusting, students who had ever used any drug had just over 3 times (aOR 3.37, 95% CI 2.8, 4.1) the odds of attempting suicide than those students who had abstained from drug use. Finally, students who were victims of electronic bullying were at 5.76 times (OR 5.76, 95% CI 4.8, 6.9, p-value <0.0001) increased odds of attempting suicide when compared to those students who were not subject to electronic bullying. After adjusting for age, gender, and race students who had been electronically bullied had almost 7 times (aOR 6.78, 95% CI 5.7, 8.1) the odds of attempting suicide when compared to those students who were not victims of electronic bullying.

Table 5 shows both crude and adjusted results of the multivariable analysis of the relationship between substance use and suicide attempts stratified by electronic bullying. After adjusting for age, gender, and race students who were not bullied and used alcohol had 3.6 times (aOR 3.61, 95% CI 2.3, 4.1) the odds of attempting suicide while students who used alcohol and were bullied had slightly lower odds of 3.42 times (aOR 3.42, 95% CI 2.2, 5.4). After adjusting, students who used heroin and were not bullied had almost 30 times (aOR 28.15, 95% 15.3, 51.8) the odds of attempting suicide than those students who did not use heroin. However, these odds dropped substantially for students who were bullied as they had almost 9 times (aOR 8.82, 95% CI 4.6, 17.0) the odds of attempting suicide than students who did not use heroin. After adjusting, students who used methamphetamines and were not bullied had almost 14 times (aOR 13.91, 95% CI 8.5, 22.9) the odds of attempting suicide while students who were bullied had lower odds of 8.62 (aOR 8.62, 95% CI 4.7, 15.7). After adjusting for age, gender, and race, students who used prescription drugs had about 5 times the odds of attempting suicide in both

students who were not bullied (aOR 5.25, 95% CI 3.9, 7.0) and students who were bullied (aOR 4.64, 95% CI 3.3, 6.6). Finally, after adjusting for cofounders, students who used any substance had about 3 times the odds of attempting suicide than those students who abstained from drug use in both students who were not bullied (aOR 3.13, 95% CI 2.4, 4.1) and students who were bullied (aOR 2.82, 95% CI 2.0, 3.9).

CHAPTER V - DISCUSSION

This study aimed to measure the associations between suicide, drug use, and electronic bullying. All three topics are all issues that affect today's adolescents and have become major areas of concern in public health. Teens are increasingly turning to prescription drugs to get high which only acts as a catalyst to seek out other more dangerous substances. Drug usage has also changed from being a problem that mostly affected impoverished minorities to having high rates of use among those who are White, suburban, and middle class. The Healthy People 2020 campaign has set several goals for changing substance use rates in adolescents. They want to increase the proportion of high school seniors who have never used alcohol or illicit drugs by 10%, reduce the proportion of adolescents reporting drug use in the past 30 days by 10%, and reduce the number of drug-induced deaths by 10% (Substance Abuse, n.d.). Suicide is also affecting an alarming number of adolescents, as it is the 2nd highest cause of death for youth ages 10-24. Healthy People 2020 has set a goal of reducing suicide attempts in adolescents by 10% (Mental Health and Mental Disorders, n.d.). Finally, increasing numbers of students are becoming victims of electronic bullying with the rise of social media. At least 25% of adolescents and teens report being bullied repeatedly through their cell phones or online (Cyber Bullying Statistics, 2015). Healthy People 2020 has set a goal of reducing bullying among adolescents by 10% (Injury and Violence Prevention, n.d.)

When looking at the proportions of how students use illicit substances, White males were the students with the highest proportion of engaging in drug use. However, the age group with the highest proportions of drug use in each category was not as consistent. 15-year-old students had the highest percentage of heroin usage, 17-year-olds had the highest percentage of alcohol use, 18-year-olds had the highest percentage of meth use, and 15- and 16-year-olds had the highest percentage of prescription drug usage. Overall among those who used drugs, 17-year-olds had the highest proportion of usage.

Although male students had the highest proportions of drug use, female students had the highest proportions of being victims of electronic bullying and attempting suicide. Race/ethnicity of students who most often attempted suicide stayed consistent with drug use and had the highest proportions in White students. This could mean that race does influence these two issues but this could also be because at 55%, White students made up most the survey. In every analysis, drug use was associated with increased odds of attempting suicide which supports the main hypothesis. Although each drug gave students increased odds of attempting suicide, heroin and meth use were associated with the highest odds, suggesting that students who use these two specific drugs show the strongest association with attempting suicide.

After adjusting for cofounders and stratifying by electronic bullying, the odds of attempting suicide in those students who used drugs and were bullied was different than the odds of attempting suicide in those students who were not bullied but still greater than 1.0. The results show that when drug use and being bullied are analyzed separately, they do have associations with suicide attempts. The results also show them when stratifying by electronic bullying led, there were changes in the odds ratio suggesting that electronic bullying is modifying this effect.

Strengths and Limitations

One strength of this study comes from the target sample of the YRBS. The YRBS is a national representative sample that includes all 50 states and the District of Columbia and students from public and private schools.

One main limitation of this study is that it is a cross-sectional examination of this association. Although the results show an association between electronic bullying and its effect on the relationship between illicit drug use and suicide, there is no way to establish directionality of the association. Do students turn to drugs after being a victimized by electronic bullying, or are they bullied because other students know they use drugs? Are students suicidal because they are using drugs, or are they using drugs because they are feeling suicidal? This study does not present a way to make causal inferences for this association.

Other limitations lie in how the YRBS data is gathered and in the questions the YRBS does not ask. Responses to the YRBS are self-reported which makes them subject to recall bias and over- or under-estimation. The survey also does not ask questions about geographical region, socio-economic status, parental education, or sexual orientation. Living in a rural area vs an urban area, being wealthy or living in poverty, and having parents with advanced educations could also impact these statistics as they could be confounding the association. Although the YRBS has been updated to include a wider range of answers for sexual orientation, it does not ask about those students who may identify as Transgender, Non-Binary, or any other designation. This could potentially limit the survey as it does not allow researchers to consider that those in gender and sexual minorities often have suicidal ideations or suicide attempts. Sample size for students who used drugs could also create bias in the results as the number of students who reported ever using illicit substances was much smaller than the number who said they had not.

Implications

This study was designed to find further information on the association between using illicit substances and attempting suicide in adolescents. The results of this study can be used to develop programs in schools that focus on ending electronic bullying which may in turn reduce both substance use and suicide attempt rates. The study also suggests that interventions may be more effective if they target substance use and electronic bullying separately because together they do not increase odds of students attempting suicide. Although the programs should not disregard males, it may be helpful for them to focus on female audiences as they showed higher proportions in this association. One systematic review found that cyberbullying intervention programs that focus on whole classrooms or entire schools are more effective than interventions aimed at individuals (Cantone, et al,. 2015). The study also found that although interventions showed short-term efficacy, very few proved to be effective long-term in reducing electronic bullying. Future interventions could be more long term and last throughout the school year which may increase efficacy. If more physicians were aware of these associations, they could be warned to be more careful with prescribing opioid pain killers and other medications that may lead to addiction. Cutting teens off from prescription drugs at the initial source could have an impact on if they even begin to use drugs. Further research could also assess whether the age at which drug use starts affects this association, how does socio-economic status affect this association, and how do the images adolescents see in the media affect this association.

Conclusion

The findings of this study indicate that overall drug use is associated with suicide attempts in adolescents and being a victim of electronic bullying is associated with suicide attempts in adolescents. Specifically using heroin and methamphetamines show an even stronger association

with students attempting suicide. The association between substance use and suicide in adolescents is further modified when students are also victims of electronic bullying. This research helps to improve understanding of the behaviors that are associated with adolescents attempting suicide. This has implications for developing targeted intervention and education programs that promote avoiding drugs, reducing electronic bullying, and decrease the number of adolescents that attempt suicide.

Tables

Table 1. Lifetime Heroin, Alcohol, or Methamphetamine Use in U.S. High School Students: Data from the 2015 YRBS

Participant Characteristic	Heroin Use N=248 (1.5%), 95% CI	Alcohol Use N=7019 (56.1%), 95% CI	Methamphetamine Use N= 307 (1.9%), 95% CI
Age			
12 years & younger	6.70% (2.1, 11.4)	0.25% (0.1, 0.4)	3.72% (1.2, 6.3)
13 years old	1.03% (0.0, 2.6)	0.03% (0.0, 0.1)	0.80% (0.0, 2.0)
14 years old	5.74% (3.0, 8.45)	6.05% (4.8, 7.3)	5.04% (2.8, 7.3)
15 years old	24.42% (18.2, 30.6)	20.30% (18.8, 21.8)	17.80% (13.3, 22.3)
16 years old	24.12% (15.6, 32.6)	25.35% (23.5, 27.2)	26.06% (18.9, 33.2)
17 years old	17.27% (9.9, 24.6)	29.10% (27.5, 30.7)	17.66% (12.1, 23.3)
18 years and older	20.72% (12.2, 29.2)	18.93% (16.7, 21.1)	28.92% (18.3, 39.5)
p-value	<0.0001*	<0.0001*	<0.0001*
Grade			
9th grade	23.87% (17.6, 30.2)	19.12% (17.1, 21.1)	16.78% (11.9, 21.6)
10th grade	27.54% (16.9, 38.2)	23.16% (21.3, 25.0)	31.31% (21.7, 40.9)
11th grade	25.88% (16.1, 35.7)	27.89% (26.0, 29.8)	19.73% (14.9, 24.6)
12th grade	19.41% (11.6, 27.2)	29.61% (27.5, 31.7)	28.32% (17.9, 38.8)
Ungraded/ other grade	3.30% (1.2, 5.4)	0.22% (0.0, 0.4)	3.86% (0.0, 7.8)
p-value	<0.0001*	<0.0001*	<0.0001*
Gender			
Female	26.70% (16.9, 36.5)	49.13% (46.2, 52.1)	33.92% (26.3, 41.6)
Male	73.30% (63.5, 83.1)	50.87% (47.9, 53.8)	66.08% (58.4, 73.7)
p-value	0.0001*	0.13	0.0051*
Race			
Am. Indian/Alaska Native	0.05% (0.0, 0.2)	0.80% (0.4, 1.2)	0.51% (0.0, 1.5)
Asian	5.82% (0.1, 11.6)	2.08% (1.0, 3.1)	4.13% (0.0, 8.3)
Black/African American	18.00% (5.7, 30.3)	10.14% (8.2, 12.1)	14.82% (7.3, 22.4)
Native Hawaiian/other PI	4.04% (0.0, 8.1)	0.75% (0.4, 1.1)	2.84% (0.0, 6.0)
White	34.35% (23.2, 45.5)	58.88% (54.3, 63.4)	35.01% (26.9, 43.1)
Hispanic/Latino	4.24% (1.5, 7.0)	9.18% (6.5, 11.9)	10.49% (3.5, 17.5)
Multiple Race/Ethnicity-Hispanic	24.75% (18.1, 31.4)	12.82% (10.4, 15.3)	23.67% (16.1, 31.3)
Multiple Race/Ethnicity-Non-Hispanic	8.75% (0.6, 16.9)	5.36%(4.4, 6.3)	8.53% (2.03, 15.0)
p-value	<0.0001*	<0.0001*	<0.001*

Note: Table include weighted frequency percentages
Note: Weighted percentages may not add up to 100% because of rounding
Note: Substance Use is measured by if students have used the substance at any point in their lifetime
***Statistically significant, α=0.05**

Table 2. Lifetime Prescription Drug or Any Substance Use in U.S. High School Students: Data from the 2015 YRBS

Participant Characteristic	Prescription Drug Use N=1665 (11.1%), 95% CI	Substance Use N=7399 (47.3%), 95% CI
Age		
12 years & younger	1.30% (0.5, 2.1)	0.35% (0.2, 0.6)
13 years old	0.16% (0.0, 0.4)	0.05% (0.0, 0.1)
14 years old	5.29% (3.2, 7.4)	6.17% (4.9, 7.4)
15 years old	19.60% (16.3, 22.9)	20.75% (19.2, 22.2)
16 years old	26.76% (23.4, 30.1)	25.34% (23.5, 27.2)
17 years old	26.09% (23.1, 29.1)	28.71% (27.3, 30.1)
18 years and older	20.80% (17.4, 24.2)	18.63% (16.5, 20.8)
p-value	<0.0001*	<0.0001*
Grade		
9th grade	19.13% (15.3, 23.0)	19.71% (17.6, 21.8)
10th grade	24.04% (20.0, 28.1)	23.38% (21.5, 25.3)
11th grade	26.32% (24.0, 28.7)	27.48% (25.7, 29.3)
12th grade	29.53% (25.3, 33.7)	29.18% (27.1, 31.3)
Ungraded/ other grade	0.99% (0.2, 1.8)	0.25% (0.1, 0.4)
p-value	<0.0001*	<0.0001*
Gender		
Female	40.14% (36.4, 43.9)	48.51% (45.5, 51.5)
Male	59.86% (56.1, 63.7)	51.49% (48.5, 54.5)
p-value	<0.0001*	0.81
Race		
Am. Indian/Alaska Native	0.87% (0.4, 1.4)	0.76% (0.4, 1.2)
Asian	2.01% (0.6, 3.4)	2.24% (1.1, 3.4)
Black/African American	13.25% (10.0, 16.5)	10.80% (8.8, 12.8)
Native Hawaiian/other PI	0.98% (0.3, 1.8)	0.79% (0.5, 1.1)
White	51.33% (45.5, 57.2)	57.79% (53.3, 62.2)
Hispanic/Latino	9.68% (6.1, 13.3)	9.26% (6.6, 12.0)
Multiple Race/Ethnicity-Hispanic	15.38% (12.1, 18.6)	13.01% (10.6, 15.4)
Multiple Race/Ethnicity-Non-Hispanic	6.51% (4.5, 8.5)	5.33% (4.4, 6.3)
P=value	0.0016*	<0.0001*

Note: Table include weighted frequency percentages
Note: Weighted percentages may not add up to 100% because of rounding
Note: Substance Use is measured by if students have used the substance at any point in their lifetime
***Statistically significant, α=0.05**

Table 3. Electronic Bullying and Suicide Attempts in the Past 12 Months in U.S. High School Students: Data from the 2015 YRBS

Participant Characteristic	Electronic Bullying N= 2268 (15.6%), 95% CI	Suicide Attempts N=572 (4.2%), 95% CI
Age		
12 years & younger	0.71% (0.2, 1.3)	0.59% (0.0, 1.2)
13 years old	0.11% (0.0, 0.3)	0.12% (0.0, 0.4)
14 years old	10.49% (7.8, 13.2)	9.77% (6.3, 13.2)
15 years old	27.15% (23.3, 31.0)	31.00% (25.5, 36.5)
16 years old	26.93% (23.4, 30.4)	26.27% (19.4, 33.2)
17 years old	20.95% (18.4, 23.5)	18.61% (14.5 22.7)
18 years and older	13.65% (11.8, 15.5)	13.64% (9.7, 17.5)
p-value	0.0003*	0.0047*
Grade		
9th grade	28.84% (24.4, 33.3)	31.69% (25.2, 38.2)
10th grade	27.30% (23.2, 31.4)	29.04% (23.7, 34.4)
11th grade	22.58% (19.4, 25.8)	21.22% (16.1, 26.3)
12th grade	21.08% (18.9, 23.3)	17.05% (13.3, 20.9)
Ungraded or other	0.20% (0.0, 0.4)	1.00% (0.2, 1.8)
p-value	0.22	<0.0001*
Gender		
Female	68.15% (63.00, 73.3)	68.13% (62.4, 73.8)
Male	31.85% (26.7, 37.0)	31.87% (26.2, 37.6)
p-value	<0.0001*	<0.0001*
Race		
Am. Indian/Alaska Native	0.73% (0.4, 1.0)	1.34% (0.3, 2.4)
Asian	3.34% (1.3, 5.4)	3.26% (1.0, 5.5)
Black/African American	7.40% (5.1, 9.7)	12.98% (7.6, 18.3)
Native Hawaiian/other PI	0.50% (0.1, 0.9)	0.15% (0.0, 0.5)
White	64.28% (59.9, 68.6)	40.68% (34.4, 47.0)
Hispanic/Latino	5.92% (4.2, 7.6)	13.06% (8.2, 18.0)
Multiple Race/Ethnicity-Hispanic	11.75% (9.4, 14.2)	19.12% (14.2, 24.1)
Multiple Race/Ethnicity-Non-Hispanic	6.08% (4.3, 7.9)	9.40% (5.9, 12.9)
p-value	<0.0001*	<0.0001*

Note: Table include weighted frequency percentages
Note: Weighted percentages may not add up to 100% because of rounding
Note: Substance Use is measured by if students have used the substance at any point in their lifetime
***Statistically significant, α=0.05**

Table 4. Bivariate and Multivariable Analysis of the Relationships between Lifetime Substance Use/ Electronic Bullying and Suicide Attempts Within the Past 12 Months Based on Data from the 2015 YRBS

Variable	No Suicide Attempts N=11364 (95.8%)	Suicide Attempts N=572 (4.2%)	OR (95% CI)	aOR (95% CI)**
Ever Used Heroin				
Yes	0.65% (0.3,1.0)	8.68% (5.4, 11.9)	18.00 (12.3, 26.3)	25.59 (16.6, 39.6)
No	99.35% (99.0, 99.7)	91.32% (88.1, 94.6)	1.00	1.00
Ever Used Alcohol				
Yes	54.77% (51.4, 58.1)	82.16% (75.9, 88.4)	3.80 (2.4, 6.1)	4.29 (3.3, 5.6)
No	45.23% (41.9, 48.6)	17.84% (11.6, 24.1)	1.00	1.00
Ever Used Meth				
Yes	0.97% (0.6, 1.3)	12.65% (8.6, 16.7)	14.76 (9.7, 22.4)	15.34 (10.6, 22.3)
No	99.03% (98.7, 99.4)	87.35% (83.3, 91.4)	1.00	1.00
Ever Used Prescription Drugs				
Yes	9.28% (7.9, 10.6)	31.91% (24.9,38.9)	4.60 (3.8, 5.6)	10.45 (8.8, 12.5)
No	90.72% (89.4, 92.1)	68.09% (61.1, 75.1)	1.00	1.00
Ever Used Any Drugs				
Yes	45.95% (43.0, 48.9)	72.37% (66.8, 78.0)	2.71 (2.3, 3.3)	3.37 (2.8, 4.1)
No	54.05% (51.1, 57.0)	27.63% (22.0, 33.2)	1.00	1.00
Ever Electronically Bullied				
Yes	13.22% (12.1, 14.3)	48.98% (42.6, 55.4)	5.76 (4.8, 6.9)	6.78 (5.7, 8.1)
No	86.78% (85.7, 87.9)	51.02% (44.6, 57.5)	1.00	1.00

Note: Table includes weighted frequency percentages

Note: Weighted percentages may not add up to 100% because of rounding

Note: Substance Use is measured by if students have used the substance at any point in their lifetime

Note: Electronic Bullying is measured by if students have been bullied within the past 12 months

Note: Suicide Attempts is measured by if students have attempted suicide within the past 12 months

*__All p-values were equal to <0.0001__

**__Multivariable model adjusts for Age, Gender, and Race__

Table 5. Multivariable Analysis of the Relationship between Lifetime Substance Use and Suicide Attempts in the Past 12 Months Stratified by Electronic Bullying Based on Data from the 2015 YRBS

Electronic Bullying	Participant Characteristic	OR (95% CI)	aOR (95% CI)**
No	Alcohol Use		
	Yes	2.98 (2.2, 4.0)	3.61 (2.3, 4.1)
	No	1.00	1.00
Yes	Alcohol Use		
	Yes	2.89 (1.9, 4.4)	3.42 (2.2, 5.4)
	No	1.00	1.00
No	Heroin Use		
	Yes	21.40 (12.5, 36.8)	28.15 (15.3, 51.8)
	No		1.00
Yes	Heroin Use		
	Yes	6.37 (3.6, 11.2)	8.82 (4.6, 17.0)
	No	1.00	1.00
No	Methamphetamine Use		
	Yes	11.24 (7.1, 17.9)	13.91 (8.5, 22.9)
	No	1.00	1.00
Yes	Methamphetamine Use		
	Yes	6.62 (3.9, 11.1)	8.62 (4.7, 15.7)
	No	1.00	1.00
No	Prescription Drug Use		
	Yes	4.04 (3.1, 5.3)	5.25 (3.9, 7.0)
	No	1.00	1.00
Yes	Prescription Drug Use		
	Yes	4.00 (2.9, 5.5)	4.64 (3.3, 6.6)
	No	1.00	1.00
No	Any Substance Use		
	Yes	2.41 (1.9, 3.1)	3.13 (2.4, 4.1)
	No	1.00	1.00
Yes	Any Substance Use		
	Yes	2.38 (1.8, 3.2)	2.82 (2.0, 3.9)
	No	1.00	1.00

Note: Table includes weighted frequency percentages
Note: Weighted percentages may not add up to 100% because of rounding
Note: Substance Use is measured by if students have used the substance at any point in their lifetime
Note: Electronic Bullying is measured by if students have been bullied within the past 12 months
Note: Suicide Attempts is measured by if students have attempted suicide within the past 12 months
[*]**All p-values were equal to <0.0001**
[**]**Multivariable model adjusts for Age, Gender, and Race**

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