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The Relationship Between Drug Use and Depressive Symptoms Among High School
Students

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B.S.N., Johns Hopkins University, 2008

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Masters of Public Health Thesis

The Relationship Between Drug Use and Depressive Symptoms Among High School Students

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Abstract

Objective: Substance use disorders and depression in adolescents is a major public health issue. The relationship between clinically diagnosed substance use disorder and depression has been established. However, this study examined the relationship between any drug use and the presence of depressive symptoms in a nationally representative sample of high school students in the United States. *Methods:* Data from the 2013 Youth Risk Behavior Survey including 13,583 high school students was analyzed. Odds ratios were calculated between substance use, depressive symptoms, gender and ethnicity. Binary logistic regression analysis examined the association between any drug use and depressive symptoms controlling for gender, age, ethnicity, smoking status and alcohol use. *Results:* Students reporting depressive symptoms had a significantly higher risk of drug use (OR=1.454 (1.408-1.502); $p < .001$). Males had a higher proportion of drug use (1.060 (1.023-1.099); $p < .001$). Other ethnicities had a higher odds ratio than white students for using any drugs (1.176 (1.340-1.219); $p < .001$). Females had a higher odds ratio for reporting depressive symptoms (OR= 1.493 (1.444-1.543); $p < .001$). Students with depressive symptoms had higher rates of drug use, $\chi^2 = 132.12$, $p < .001$, $b = -0.619$, S.E.=0.054, Wald=131.569, $p < .001$. *Conclusions:* This study established that there is a strong association between substance use and depressive symptoms among adolescents. The relationship between substance use and depressive symptoms outside of a clinical diagnosis demonstrates the need to screen students and intervene early to prevent adolescent symptoms from becoming lifelong battles.

Introduction

Mental health disorders are both prevalent and pervasive in society. Kessler et al. found that 26.2% of the adult population fits the diagnostic criteria for one of the many diagnosable mental disorders (Kessler et al, 2005). This high prevalence rate, over a quarter of the population affected, makes mental disorders an important public health issue. There are a wide variety of mental disorders, of these, 3.8% are reported as a substance use disorder and 6.7% are reported as a major depressive disorder (Kessler et al., 2005). There are strict diagnostic criteria used to determine the presence of a clinically significant mental disorder, which is diagnosed by a physician or specialist. Among these defined mental disorders there are also levels of severity: mild, moderate and serious (Kessler et al., 2005). Of diagnosed mental disorders, 22.3% presented as serious, 37.3% presented as moderate and 40.4% presented as mild (Kessler et al., 2005). Beyond those disorders that are determined to be clinically significant and are diagnosed, many people can exhibit symptoms of mental disorders without necessarily being diagnosed.

Mental disorders often co-occur in the same individual. Co-morbidity of mental disorders is extremely common; at least 40% of adults with one lifetime diagnosed mental disorder have a history, or current diagnosis, of another mental disorder (Kessler et al., 2005; Aseltine et al., 1998). Co-morbidity of mental disorders among adolescents is also high (Kessler et al., 2012). This is important in the study of mental disorders since very rarely are investigators and clinicians dealing with one specific, perfectly isolated mental disorder. One study found that 27.9% of adolescents meet criteria for two or more mental disorders and in this group, the average number of

disorders was 3.5 (Kessler et al., 2012). Rather, the patients have much more complex diagnoses with multiple co-morbidities, all with potentially differing levels of severity. This complication of co-morbidity makes identifying those with needs difficult and successful treatment plans challenging (Aseltine et al., 1998).

A common co-morbidity is that of mood disorders and substance abuse. The relationship between depression and substance abuse has been documented in adult studies as well as in adolescent studies (Rao, 2006; Weller & Weller, 2000; Zullig & Divin, 2012; Martins et al., 2012; Marmorstein et al., 2010; Chinet et al., 2006; Aseltine et al., 1998; Deykin et al., 1987; Roa et al., 2000). The temporality of these two disorders is still unclear, as studies have shown either disorder may influence the other disorder (Martins et al., 2012). Kessler et al. (2012) found in a retrospective analysis of the NCS-A data that primary mental disorders with age of onset within adolescence were predictive of later mental disorders, especially fear disorders. People with major depression disorder may self medicate with substances to alleviate symptoms and, in turn, substances may induce major depression. In whichever order depression or substance abuse occurs in the population, these disorders afflict a large percentage of the population and are a current, increasing public health issue. Though many studies have been conducted in the adult populations, these disorders often begin in adolescence (Kessler et al., 2012).

Most of the research available pertaining to substance use disorders and depression in adolescents includes clinically diagnosed populations. These are adolescents with a clinically significant, diagnosed disorder. One study of African American adolescents aged 12 to 18 years, found that 26% were reporting symptoms

of depression, but not enough to be clinically diagnosed with depression according to DSM-IV standards (Taylor, 2011). Though these adolescents may not be clinically diagnosed as having a depressive disorder, they are still exhibiting symptoms of depression that could be detrimental to themselves and lead to other negative activities such as substance use (Taylor, 2011). In addition, adolescents may use different substances, but may not fall under the diagnosable definition of a substance use disorder. Adolescents who engage in periodic substance use may still experience negative effects and potential hazards of using different substances such as increased risk of suicide (Rao et al., 2000; Wong et al., 2013). Large epidemiological studies have established the prevalence rates of clinically significant and diagnosed disorders, but establishing the prevalence of those who exhibit sub-threshold symptoms is challenging (Baumeister & Harter, 2007). Often these sub-threshold symptoms are predictors of a later clinical diagnosis (Baumeister & Harter, 2007; Taylor, 2011). Using stringent criteria established by diagnostic criteria misses a large portion of the adolescent population, who may be suffering from depressive symptoms. Even though these adolescent's symptoms may not rise to the level of a clinical diagnosis, they may still have negative effects on that adolescent's life (Deykin et al., 1987).

In this study, strict definitions of substance abuse and depression were not utilized. In order to measure depression in this study population, one question concerning feeling sad for two consecutive weeks over the last twelve months was utilized. Though this is not a strict diagnosis of depression, it captures a large number of students who may or may not have a diagnosis, but may be showing early signs of

depression. As much as 70% of adolescents that show some signs of depression, sub-clinically, known as dysthymia, go on to develop a major depressive disorder (Weller & Weller, 2000). Though clinical significance may bring a child into a pediatrician's office, it is difficult to determine where the line of significance is exactly. It is difficult to determine at what point feeling sad becomes a problem and at what point does casual use of illegal and legal substances require intervention. Other studies have used various techniques to define depression and depressive symptoms. Zullig & Divin (2012) also used generic questions about depressive symptoms as a substitute for a clinical diagnosis in order to capture a larger sample that may be suffering from any depressive symptoms.

Many studies have been done on specific adolescent populations such as those in treatment facilities for substance abuse or clinically diagnosed with depression with comparatively small sample sizes. This study seeks to examine the relationship between drug use and depressive symptoms among a large, nationally representative sample of high school students. The differences in substance use according to adolescent gender, race and age, as well as differences in the presence of depressive symptoms among these groups will be examined. The variables are not clinically diagnosed disorders, but representations of those that display clinical symptoms of depression or substance abuse.

Methods

This is a cross sectional study based on a secondary data analysis of the 2013 data set from the Youth Risk Behavior Surveillance System (YRBS). The YRBS was developed in 1990 by the Centers for Disease Control and Prevention (CDC) to

monitor health risk behaviors that lead to death and/or disability in the United States among high school students. Starting in 1991, the CDC has collected data from more than 2.6 million high school students. The CDC conducts the YRBS every other year. The YRBS is administered to 9th-12th grade students who attend national, state, territorial, tribal, local, public and private schools. The YRBS is anonymous and voluntary. In the 2013 YRBS, high school students in grades 9 through 12 in all 50 states and the District of Columbia were included in the sampling. The YRBS uses a three-stage cluster sampling design including states and large urban school districts, which are sorted by districts and number of students per grade (Brener et al., 2013). One or two classes in each grade are randomly chosen from selected schools to participate in the YRBS (Brener et al., 2013). For complete details on the sampling strategy, see the CDC YRBS methods (Brener et al., 2013). Of the 193 schools selected, 148 participated yielding a 77% school response rate. In total, 15,480 students were sampled and 13,633 of the sampled students submitted questionnaires; of those, 13,583 questionnaires were usable after editing, an 88% student response rate. The edits conducted by the CDC consisted of reviewing surveys for inconsistencies such as an illogical range in height and weight. The overall response rate was calculated by multiplying the school response rate by the student response rate, which resulted in a total response rate of 68%.

The primary outcome measure used for this study was student report of any drug use during their lifetime of one or more of the nine substances examined in the survey. The nine substances included: marijuana, cocaine, inhalants, heroin, methamphetamines, ecstasy, steroids, prescription medications and hallucinogens.

Each of these substance variables were recoded into dichotomous variables, with yes indicating use one or more times in their lifetime and no indicating that that substance was never used. A new summative variable was created to evaluate the number of students who had ever used any one or more of the nine substances listed above. This new variable for any drug use, as well as the variables for each individual drug measured lifetime use with yes indicating that that student had used one or more substances one or more times in their life and no indicating that that student had never used one of the nine substances in their lifetime. Two different variables were also utilized to represent cigarette and alcohol use. Cigarette use was based on lifetime use or not of cigarettes. Alcohol use was demonstrated through the variable measuring the student reporting having one or more drink on one or more days within the last 30 days. Alcohol use was measured over the past 30 days instead of lifetime because of the high prevalence of one time use over the lifetime and to exclude those students who may have tasted alcohol in a religious or family tradition and not use independently.

The predictor variable investigated was student report of depressive symptoms, defined by the YRBS question: During the past 12 months, did you ever feel so sad or hopeless almost every day for two weeks or more in a row that you stopped doing your usual activities? This variable is dichotomous; yes indicating that that student felt sad for two weeks or more and no indicating that that student did not. The YRBS collects data on ethnicity as well. The myriad of combinations and responses for ethnicities were dichotomized for the purpose of this study into White and Non-White ethnicities. The original categories included in the Non-White

category were American Indian, Alaskan Native, Asian, Black, Native Hawaiian, Pacific Islander, Hispanic/Latino and any combination to include those students who identify with multiple ethnicities. Age, 14 to 18 years, and gender were also analyzed.

The data were analyzed using the IBM SPSS Statistics software. Frequencies and prevalence were run on the different variables. Odds ratios were calculated between use of any drug and depressive symptoms, gender and ethnicity. Odds ratios were also calculated between depressive symptoms and gender and depressive symptoms and ethnicity. Logistic regression analysis examined the relationship between any drug use and depressive symptoms controlling for gender, age, ethnicity, smoking status and alcohol use.

Results

Table 1: Demographics of the high school students who participated in the 2013 Youth Risk Behavior Survey; N= 13,583.

<u>Sex</u>	
Male	(6,950) 51.2%
Female	(6,621) 48.7%
<u>Age</u>	
14 years or younger	(1,412) 10.5%
15 years old	(3,098) 22.8%
16 years old	(3,203) 23.7%
17 years old	(3,473) 25.6%
18 years old or older	(2,320) 17.1%
<u>Race/Ethnicity</u>	
Non-Hispanic White	(5,449) 41.1%
Non-white ^a	(7,816) 56.7%
<u>Students Who Report Depressive Symptoms</u>	
All	(4,086) 29.9%
Males	(1,492) 21.6%
Females	(2,592) 39.3%
White	(1,527) 28.2%
Non-white	(2,466) 31.8%
<u>Students Who Report Use of Any Drug</u>	

All	(6,584) 51.5%
Males	(3,431) 52.9%
Females	(3,146) 50.1%
White	(2,435) 46.9%
Non-White	(4,013) 54.8%

a- Other race/ethnicities include: American Indian, Alaskan Native, Asian, Black, Native Hawaiian, Pacific Islander, Hispanic/Latino and multiple ethnicities.

Table 2: Prevalence of substance use among all students, substance use among students who report depressive symptoms and substance use among students with no depressive symptoms.

Substance	All Students	Depressive symptoms	No depressive symptoms
Marijuana	40.7% (5,782/13,244)	54.3% (2,162/3,979)	39.0% (3,580/9,187)
Cocaine	5.5% (749/13,457)	9.2% (372/4,050)	3.9% (367/9,329)
Inhalants	8.9% (1,178/13,369)	15.6% (628/4,028)	5.8% (539/9,268)
Heroin	2.2% (303/13,255)	3.8% (150/3,991)	1.6% (147/9,192)
Methamphetamines	3.2% (415/13,357)	5.6% (224/4,017)	2.0% (187/9,266)
Ecstasy	6.6% (939/13,354)	11.0% (443/4,017)	5.2% (485/9,261)
Steroids	3.2% (419/13,454)	5.0% (203/4,052)	2.2% (208/9,326)
Prescription Meds	17.8% (2,351/13,443)	27.0% (1,093/4,050)	13.3% (1,243/9,318)
Hallucinogens	7.2% (898/12,520)	11.1% (422/3,793)	5.4% (467/8,657)
1+ Substances	51.5% (6,584/12,775)	65.7% (2,554/3,886)	45.2% (3,984/8,815)
Ever cigarette use	40.6% (5,360/13,203)	52.0% (2,070/3,981)	35.6% (3,256/9,152)
1+ days had drink in last 30 days	35.6% (4,373/12,228)	46.7% (1,1705/3,649)	30.9% (2,645/8,570)

Table 3: Odds Ratios between drug use, depressive symptoms, gender and ethnicity.

	X ²	P value	Odds Ratio (95% CI)
<u>Use of any drugs</u>			
Depressive Symptoms	454.982	<.001	1.454 (1.408-1.502)
Male Gender	10.211	<.001	1.060 (1.023-1.099)
Other Ethnicity	76.406	<.001	1.176 (1.134-1.219)

<u>Depressive Symptoms</u>			
Female Gender	500.404	<.001	1.493 (1.444-1.543)
Other Ethnicity	19.817	<.001	1.072 (1.040-1.105)

In the sample of high school students, 51.5% admitted to using one of the nine substances in their lifetime. Further breakdown of the prevalence of use of each individual substance can be found in Table 2. Marijuana was the substance with the highest prevalence with 40.7% of the students reporting use. The substance with the second highest prevalence was taking a prescription medication without a doctor's prescription at 17.8%. The least often reported substance was heroin with 2.2% of the population using this substance. The two other substance variables analyzed were lifetime use of cigarettes (40.6%) and having a drink on one or more days within the last 30 days (35.6%). Depressive symptoms were reported by 29.9% of the students. Of those that reported depression symptoms, 65.7% reported using one or more of the nine substances. The students who did not report depressive symptoms reported use of one or more drugs as 45.2%.

Each of the examined OR were statistically significant (all $p < .001$). Students reporting depressive symptoms had a significantly higher rate of drug use (OR=1.454 (1.408-1.502, $\chi^2=454.98$, $p < .001$). Males reported more drug use than females (1.060 (1.023-1.099); $p < .001$). Non-white ethnicities had a higher odds ratio than white students for using any drugs (1.176 (1.134-1.219); $p < .001$). Females had a higher odds ratio than men for reporting depressive symptoms (OR= 1.493 (1.444-1.543); $p < .001$) as well as ethnicities other than white (OR= 1.072 (1.040-1.105); $p < .001$).

Binary logistic regression assessed the relationship between age, gender, ethnicity, smoking history, recent drinking history and depressive symptoms and any history of drug use. There was a significant difference between students who used any one versus none of the nine drugs, $b=0.020$, $SE=0.019$, $Wald=1.15$, $p=.28$. There is a significant effect of gender on drug use, $\chi^2= 9.89$, $p=.002$, $b=0.119$, $S.E.=0.038$, $Wald=9.89$, $p=.002$, such that male students reported higher rates of drug use than female students. Students of races and/or ethnicities other than non-Hispanic white reported using drugs at a significantly higher rate than their white counterparts, $\chi^2= 48.725$, $p <.001$, $b=0.268$, $S.E.=0.038$, $Wald=48.60$, $p <.001$. Age had a significant effect on drug use, with older students reporting more drug use history than younger students, $\chi^2= 255.787$, $p= <.001$, $b=0.246$, $S.E.=0.016$, $Wald=249.740$, $p= <.001$. Lifetime smoking status and alcohol consumption in the last 30 days were both significant in the model for predicting students drug use with tests statistics $\chi^2= 4232.52$, $p <.001$, $b=-2.100$, $S.E.=0.051$, $Wald=1686.988$, $p= <.001$ and $\chi^2= 4232.52$, $p <.001$, $b= -1.671$, $S.E.=0.052$, $Wald=1024.877$, $p <.001$ respectively. Those who reported ever having smoked a cigarette or drinking on one or more days in the last 30 days, were more likely to use one or more of the nine substances. When lifetime smoking status and recent history of drinking were entered into the model, gender was no longer significant, $b=0.075$, $SE = 0.048$, $Wald=2.506$, $p=.113$.

The final model was calculated to predict drug use and included depressive symptoms after controlling for age, gender, ethnicity, smoking status and recent drinking history. Those reporting the presence of depressive symptoms were more

likely to report drug use, $\chi^2= 132.12$, $p <.001$, $b=-0.619$, $S.E.=0.054$, $Wald=131.569$, $p <.001$. Each of the predictors remained statistically significant ($p <.001$) in the final model.

Discussion

The findings of this study demonstrate that a history of depressive symptoms is associated with a history of illicit drug use regardless of gender and ethnicity in a nationally representative sample of high school students in the United States. In this study, students who reported depressive symptoms were more likely to have tried marijuana, cocaine, inhalants, heroin, methamphetamines, ecstasy, steroids, prescription medications or hallucinogens regardless of ethnicity or gender. This is indicative of a strong association between drug use and depressive symptoms. Though this study does not address the subject of causality or temporality between substance use and depression present in these students, it does demonstrate that depressive symptoms and substance use are linked. This is consistent with previous research that has focused on clinically diagnosed adolescents with either condition (Rao et al., 2000; Libby et al., 2005; Rohde et al., 2001; Marmorstein et al., 2010). This shows that though these students may or may not have a specific clinical diagnosis of a mental disorder, history of substance use and the presence of depressive symptoms are strongly associated with one another.

Adolescence is a time of change, self-discovery and challenges. Adolescents face numerous challenges and changes in their bodies, minds and social spheres as they navigate through this time period, which makes this a high risk time period (Rao, 2006). Adolescence is a time of transition into early adulthood as young minds

develop, personal adjustments are made, and social pressures abound (Marmorstein et al., 2009). Often, in the struggle to find themselves, adolescents engage and experiment in risky behaviors (Taylor, 2011). Since adolescence is such a crucial transition period in life, with many new experiences and emotions and often in extremes, this is also the time frame in which many mental disorders first develop (Marmorstein et al., 2009; Taylor, 2011). Though everyone at some point in their lives feels stressed, depressed, anxious or sad, when these emotions occur for extended lengths of time, normal daily functioning can be affected. For many years it was thought that depression could not occur in adolescence (Taylor, 2011). Often emerging mental disorder symptoms, such as changing abnormal moods and behaviors, are seen as normal teenage angst or rebellion against school, parents and peers (Weller & Weller, 2000). Research has established evidence that mental disorders such as major depression and substance abuse are prevalent in the adolescent population. Often it is in adolescence that these 'adult' diagnoses first appear. The incidence of depression and substance abuse in adolescents is 5-10% (Rao, 2006). This increase in prevalence of adolescent mental disorders may be due to the awareness that these diagnoses do exist in this population. Growing research in this area has found prevalence rates of clinically diagnosed depression among adolescents anywhere from 6.3% to 10.3% (Baumeister & Harter, 2007; Taylor, 2011; Libby et al., 2005; Deykin et al., 1987). The prevalence rate of substance abuse is approximately 2-28%, with 28% being much higher than the average of around 2-9% (Sung et al., 2004; Libby et al., 2005; Deykin et al., 1987), with the rate of use being much higher. In this study, which did not look at a clinical diagnosis of

substance abuse, but rather the history of any substance use, the prevalence rate was much higher. The prevalence rate for any substance use history among this population was 51.5%.

Among adolescents, co-morbidity is more a rule than the exception. While adults have co-morbid rates of approximately 40%, adolescents can have co-morbid rates of mental disorders as high as 90% (Weller & Weller, 2000; Rohde et al., 2001). As with adults, the most common co-morbid mental disorders are mood disorders, anxiety disorders and substance abuse, although this co-occurrence appears to be stronger in adolescents than in adults (Marmorstein et al., 2009). A particular pattern has been emerging from adolescent studies in community settings: co-morbid rates of depression and substance use and abuse are among the most common co-occurring disorders (Martins et al., 2012; Taylor, 2011; Aseltine et al., 1998). Adolescents have the highest risk for the onset of both depression and substance use disorders and the co-morbidity of these disorders is even higher among adolescents than adults (Rao et al., 2000). Fifteen to 24 year olds have the highest rate of prevalence of 12-month mental disorders, and the highest level of co-morbidity as well (Aseltine et al., 1998). Examining this rate of co-occurrence in adolescents is important as early onset doubles the risk for developing or persisting mental disorders later in life into adulthood (Aseltine et al., 1998). This is significant in adolescents because the presence of a disorder in adolescence is highly correlated with the presence of a disorder in adulthood. Substance abuse demonstrates significant stability over time with 66% of adolescents with substance abuse continuing to have this diagnosis into early adulthood (Aseltine et al., 1998).

Depression in adolescents continues into adulthood at a rate of 60-70% (Weller & Weller, 2000). Adolescents with one diagnosis were more than twice as likely to develop a second mental health diagnosis as adults (Aseltine et al., 1998). In this study, the prevalence of students who reported depressive symptoms as well as any substance use history was 65.7%, which is consistent with previously established prevalence rates (Aseltine et al., 1998; Weller & Weller, 2000).

One explanation for the more frequent occurrence of co-morbidities in adolescence is their developing brain. Rao (2006) found that animal studies indicate that adolescent substance use can have a stronger effect on the brain than adult brains, leading to more severe dependence. Substances are highly rewarding but withdrawing from substances can also trigger depressive symptoms or mood, and when depression is co-morbid, function is further compromised (Rao, 2006). There are also much stronger social pressures during adolescence. Social interactions are influential throughout the lifespan, but at this important time of development and new perceived independence, social pressures are especially influential. One study, Aseltine et al. (1998), found that positive relations with peers was associated with lower levels of depression and peer pressure is strongly associated with substance abuse.

Depression has been found to occur early in childhood, frequently between the ages of 13 and 15 years old, with some studies suggesting that depression may actually be symptomatic even earlier in childhood (Sung et al., 2004). Substance use was found to increase if initiation of use occurred before age 13 (Sung et al., 2004). For those adolescents who were introduced to drug use at such early ages, the

amount of drug use increased, placing these adolescents at a higher risk of dependence and other negative effects of substance use. Early use of substances also increased the likelihood of using substances later in adolescence and early adulthood (Chinet et al., 2006). This was also found to be true when comparing adolescents to young adults. Those who initiated substance use in their adolescence are more likely to engage in substance use in their adulthood and develop more serious substance abuse and dependence.

Mental health disorders are important to recognize early and provide treatment opportunities because of the negative impact they can have throughout the lifespan. Mental health disorders can begin in adolescence and become life long battles if undiagnosed, untreated, mistreated or undertreated. Early onset of mental disorders in adolescents is associated with developing Kinner et al. (2001) found the relationship between drug use and psychological health to be linear; the more drugs consumed, the poorer the psychological health. Though adolescents can be adaptive, difficulties at any point in this stage of life may effect further adaption and quality of life into adulthood (Aseltine et al., 1998). Substance use disorder and depression are associated with significant psychosocial dysfunction, and when these two disorders are co-morbid, the dysfunction is even more severe (Rao et al., 2000).

There are many other negative associations with substance use and depression that have been explored in adult populations and adolescent populations. Negative risks from depression and substance use in adolescence are especially significant because they can deter later success in adulthood. Substance use and depression are associated with behavioral problems, low academic competencies,

poor interpersonal relationships, increased utilization of services and an elevated risk of suicide (Rao et al., 2000). Substance use disorders in adolescence are associated with hospitalization, depression, suicide, HIV, and poor family function (Drake et al., 1998). Alcohol and drug use negatively affects family functioning, academic performance and lessens the possibility of college (Aseltine et al., 1998). Other consequences from substance use and depression include: high levels of stress, poor coping, low academic achievement, low parental support, poor behavioral control, and parental or peer substance use (Chassin et al., 2002). These negative outcomes of substance use and depression could also be potential risk factors for both substance use and depression creating an almost cyclic effect of exposures.

Suicide is a severe and devastating occurrence that is associated with drug use and depression. Suicide is now the third leading cause of death among adolescents (Wong et al., 2013). Suicide has become a leading cause of death among adolescents and an important public health concern. Among adolescents, suicide is especially disheartening since those who were suffering had not yet even reached adulthood. The suicide rate for adolescents has quadrupled over the last 40 years; in 1950 the rate was 2.7 per 100,000 and in 1990 was 11.1/100,000 (Weller & Weller, 2000). Wong et al. (2013) found that use of drugs significantly increased the odds of adolescents reporting suicidal ideations, suicidal plans, suicide attempts and suicide attempts resulting in severe injury. Among students who used heroin, suicide attempts occurred at rate three times as much as those students who did not use heroin (Wong et al., 2013). Among students who did not report using any type of substance, the suicide rate among high school students was 2.2%, and increasing th

number of substances used, the rate of suicide attempt also increased with students who used five or more substances having a suicide attempt rate of 18% (Wong et al., 2013). The other significant risk factor for suicide among adolescents is depression. Of high school students who report depressive symptoms, 21.6% attempted suicide (Wong et al., 2013).

Research has shown that females are more likely to experience depression than males (Weller & Weller, 2000; McHugh et al., 2013; Taylor, 2011; Chinet et al., 2006; Aseltine et al., 1998). Males tend to use substances generally more than females (McHugh et al., 2013). Females may generally report more depression and males may generally report more substance abuse, but when the two problems co-occur the gender difference disappears (Aseltine et al., 1998). If there is a substance use disorder present before the age of 17, both males and females are at an increased risk of having a substance use disorder at age 24 (Marmorstein et al., 2009). Females with substance abuse disorder report greater functional impairment, greater psychiatric severity and a higher likelihood of reporting use of substances to cope with emotional distress (McHugh et al., 2013). Substance use and depression are more strongly associated within females than males (Marmorstein et al., 2009). Females reported greater impairment than males did in employment and social and family functioning (McHugh et al., 2013). For females, if depression occurs before the age of 17 years old, they are four times more likely to continue to have depression into their adulthood (Marmorstein et al., 2009). The risk for depression in women with substance use disorders is high, with 71.4% of the females with substance abuse during follow up also having a comorbid diagnosis of depression (Aseltine et al.,

1998). There are some differences in the substances that each gender chooses to engage in, for example, prescription medication misuse is more common among white, young females (Bohnert et al., 2013) while males tend to drink more often and heavier than females (Chassin et al., 2002).

In this study, female students were found to have a high risk of reporting depressive feelings. Evidence suggests that this pattern continues into adulthood where women are more prone to be depressed than men. However, there was no difference in the likelihood of using illicit drugs between males and females in this study; 50.1% of the high school female population reported using at least one of the nine substances compared to 52.9% of males. With high rates of drug use history and higher rates of depressive symptoms, females may be at more risk than males for future negative outcomes. As studies have shown, females with depressive symptoms in their adolescence are more likely to be depressed as adults and also have substance use disorders (Aseltine et al., 1998; Marmorstein et al., 2009).

There are a wide variety of substances both legal and illegal available to adolescents. The availability and prevalence of some substances may differ among geographical regions, but essentially almost all substances are available across the nation in rural and urban communities. Alcohol and marijuana are the most widely used substance among adolescents. Among adolescents, 6.5% state that they use marijuana daily (Chinet et al., 2006). Prescription medication misuse has become an increasingly concerning trend. The Drug Abuse Warning Network has reported medical emergencies involving the misuse of prescription medications has increased 81% (Zullig & Divin, 2012). Studies have shown that adults are increasingly misusing

their prescription medications and this trend has appeared in the adolescent population as well (Bohnert et al., 2013). There is a high correlation between prescription drug misuse and heroin use (Bohnert et al., 2013). Prescription medications are highly reinforcing, similar to heroin, and prolonged use can produce neurological changes and dependence (Martins et al., 2012). In 2005, 8.2% of adolescents misused prescription medications and the risk for misusing prescription medication was three times higher when the adolescent also had a diagnosis of major depression (Schepis & Krishnan-Sarin, 2008). Only past month use of alcohol, tobacco and marijuana exceeds the rate of prescription medication misuse (Schepis & Krishnan-Sarin, 2008). Accumulating findings are showing that though males tend to be at a greater risk of substance use, females are at a greater risk for prescription medication misuse (Schepis & Krishnan-Sarin, 2008).

Marijuana, cigarettes, and alcohol are the most used substances among students, both with and without depressive symptoms, but even among these three popular substances, those with depressive symptoms had a higher prevalence of use than those without depressive symptoms. Overall, 40.7% of students reported lifetime marijuana use, and 54.3% of students who reported depressive symptoms also reported ever using marijuana. For every substance, use was higher among students with depressive symptoms. Females may be more prone to use prescription medication because it is technically legal, deemed safe, prescribed by a doctor and often easily swallowed (Schepis & Krishnan-Sarin, 2008). Regardless of substance of choice, the presence of depressive symptoms increased the likelihood of a drug use history.

Risk factors for developing depression or using substances have been explored in many studies, but many remain uncertain and there is a lot of variation. Aseltine et al. (1998) in a review of the literature found that many risk factors are associated with increased substance use and depression such as a stressful family life, poor family relationships and negative social relationships. Though family situations are important in contributing to an adolescent's mental health and social adaptation, in this malleable stage of development, peers are often more strongly linked with drinking and drug use. An adolescent's failure in self-regulation is also an important contributing risk factor for substance use. Schepis & Krishnan-Sarin (2008) found African American or Hispanic was protective for prescription drug abuse but in the present study, non-white students were found to be at higher risk for both depressive feelings and substance use. This finding suggests non-white adolescents may be at a higher risk for potential negative outcomes from both substance use and depression.

Among adolescents, some risk factors are unique to this stage in life, including boredom, peer pressure, curiosity, drug availability, and frustration (Taylor, 2011). Low socioeconomic status and poverty have also been linked to depression and substance abuse (Taylor, 2011). Adolescence is also a time for experimenting. Adolescents experiment with style, interests, hobbies, friends, and behaviors. It is not clear if experimentation with different substances increases the risk of developing substance abuse or depressive symptoms, but some studies have shown that adolescents who are depressed progress much quicker to clinical substance use disorders when they engage in experimentation with substances than adolescents

who are not depressed (Rao et al., 2000). Though this study does not distinguish between experimenters and regular users, it does capture both of students who have used only a few times as well as those who use substances regularly.

Though independent risk factors may influence the development of either a substance use disorder or depression, one disorder may influence the development of the other as well. There are several different theories regarding the association between substance abuse and depression. These include that substance use triggers depressive symptoms, those with depressive symptoms use substances in order to self medicate, and a shared influence in which there is a third factor which increases the likelihood of each disorder occurring (Martins et al., 2012). It is difficult to determine the temporality of either disorder. Evidence has been recorded for all three variations of the timing of depression and substance use (Martins et al., 2012). In one study, they found that 70% of adolescents with a substance use disorder had depressive symptoms prior to their substance use disorder, while 30% experienced depressive symptoms at the same time or after their substance use disorder developed (Libby et al., 2005). When substance use was reported first, 71% of these were boys and 37% white (Libby et al., 2005). One study found that low self-esteem induced drug use, which in turn actually increased self-esteem, leading the investigators to infer that depression lead to first substance use (Deykin et al., 1987). Though it is potentially helpful to learn which mental disorder first arises, the temporality of these disorders eventually becomes less important since both disorders are linked (Deykin et al., 1987). The fact that both of these disorders occur

in adolescence is more important to address because of the detrimental effect these disorders have on chronic disability and functioning (Deykin et al., 1987).

The risk factors often associated with depression and substance use can be interchangeable. Poor family situations, stress at home, low socioeconomic status, negative peer pressure and parental substance use or depression are all risk factors for both depression and substance use. It is important to note that though these are separate diagnoses, in adolescence, where co-morbidity is more common than in adult populations, treating them as separate diagnoses may not be as effective in this population. Many of these students may also be presenting with sub-threshold symptoms of either substance use or depression, so special attention should be given to these students and this situation. This study shows that use of even one drug of the nine different substances examined, is associated with depressive symptoms regardless of gender or ethnicity. Adolescents with substance use disorders may fail to develop adaptive methods of coping with negative feelings or stressful situations and this may lead to depressive feelings (Marmorstein et al., 2009). Experimentation of even one substance a few times and the association with depressive symptoms could be indicative of a potential future diagnosis, or one of the many negative outcomes that may occur from development of a mental disorder.

The importance of these relationships and the high prevalence of use and depressive symptoms in students emphasize the need for understanding the motivations behind drug use and to help develop specific treatments and interventions (Rigg et al., 2010). Since it is difficult to determine causality and the high rate of co-morbidity, these two diagnoses should not be considered as linked

processes that most likely influence each other. The risk factors should be examined for both substance abuse and depression to find those that are most linked to both disorders. This could create a comprehensive platform in which interventions could be assembled to address both problems. Treatment is difficult and often unsuccessful for people with co-morbid mental disorders (Drake et al., 1998). A study found that only 31% of those with co-morbid diagnoses completed intensive integrated programs (Drake et al., 1998). It is essential to have early intervention programs and specific prevention programs. Research in adults has shown treatment of one disorder such as depression can positively effect the other co-morbid disorder (Rohde et al., 2001). Early intervention and awareness of these mental disorders, in all manifestations, can help in the prevention of substance use or depression effecting adolescence and address the symptoms before it becomes a problem.

Limitations

There are several limitations to this study. The first is that this is a cross-sectional study design, which examines a sample at a specific moment in time. This study design does not allow for inferences in the direction of causality between the two variables of depressive symptoms and substance use. This study can only look at the associations between the two variables at this specific time. A prospective study considering several years of data would be better able to assess direction and causality.

This study also did not measure specific diagnoses. Though this study design allowed for a larger sample size and was more inclusive to include those that may have symptoms but not necessarily a disorder, it also potentially includes those who

do not have a mental disorder and may never develop one. Student report of feeling sad was used to represent depressive symptoms, but does not differentiate those students who may also be diagnosed with depression. Substance use was based off of lifetime use of any drug with one time use of any drug being a positive answer. This strategy includes all students who have used a substance in their lifetime, but does not differentiate between frequent or current use of substances. This method could potentially include students who have tried a substance once, but currently do not use substances and may never use again.

In this study, no other baseline information was taken from students to determine if there are other associations with being in either ethnicity sub category. The non-white ethnicity group includes minority populations that are often associated with living in urban, underserved areas and lower socioeconomic status. This may be a significant contributing factor to the increased rate of substance use and depressive feelings among non-white students. This is an important and intriguing topic for future research.

The most important limitation of this study was the lack of assessment of other potentially influential confounders. The YRBS does not assess many aspects of the students' life inside the home or their family situations. The study is limited by the lack of access to information about the students' socioeconomic status, location, family structure, parental relationships and adverse childhood exposures. There are many other aspects of the adolescents' lives that could potentially influence the use of substances or the development of depressive symptoms. Family situations are highly influential in an adolescent's life and this domain of adolescent life warrants

further investigation. Other adverse childhood events such as abuse, neglect, parental substance use, parental depression, foster care, injury, illness and others could potentially influence the development of either depression or substance use. This study also did not address other mental disorders that occur during this time in adolescence, such as anxiety and conduct disorders.

Conclusions and Recommendations

Adolescence can be a difficult and exciting time for many. It is also a time where emerging mental health and substance use disorder symptoms of mental disorders that can have lifelong effects first occur. The potential negative effects and persistence into adulthood of these symptoms of mental disorders makes recognizing and addressing these emerging mental disorders in adolescence a priority.

Substance use and depression are associated with increased disability, morbidity and mortality if they persist into adulthood. This study established that there is an association between substance use and depressive symptoms among high school students. The presence of any drug use history and feeling sad were associated. These broad categories across a large, national sample of high school students demonstrate the pervasive problem that exists. Substance use and depressive symptoms are not isolated to a specific subgroup of the population and many different substances are utilized.

Further research examining the changes in these populations over time may yield further insight into this relationship across specific subgroups of adolescents. Continued research of potential at risk populations may further help design and establish targeted interventions. Understanding the relationship and possible risk

factors between depression and drug use in adolescence ultimately needs to lead to potential interventions that will be targeted to treat these individuals early and prevent adolescent symptoms from becoming lifelong battles.

Appendix

Youth Risk Behavior Surveillance Survey Questions

Q1: How old are you?

- A. 12 years old or younger
- B. 13 years old
- C. 14 years old
- D. 15 years old
- E. 16 years old
- F. 17 years old
- G. 18 years old or older

Q2: What is your sex?

- A. Female
- B. Male

Q5: What is your race? (Select one or more responses.)

- A. American Indian
- B. Asian
- C. Black or African American
- D. Native Hawaiian or Other Pacific Islander
- E. White

Q26: During the past 12 months, did you ever feel so sad or hopeless almost every day for two weeks or more in a row that you stopped doing some usual activities?

- A. Yes
- B. No

Q31: Have you ever tried cigarette smoking, even one or two puffs?

- A. Yes
- B. No

Q43: During the past 30 days, on how many days did you have at least one drink of alcohol?

- A. 0 days
- B. 1 or 2 days
- C. 3 to 5 days
- D. 6 to 9 days
- E. 10 to 19 days
- F. 20 to 29 days
- G. All 30 days

Q47: During your life, how many times have you used marijuana?

- A. 0 times
- B. 1 or 2 times

- C. 3 to 9 times
- D. 10 to 19 times
- E. 20 to 39 times
- F. 40 to 99 times
- G. 100 or more times

Q50: During your life, how many times have you used any form of cocaine, including powder, crack, or freebase?

- A. 0 times
- B. 1 or 2 times
- C. 3 to 9 times
- D. 10 to 19 times
- E. 20 to 39 times
- F. 40 or more times

Q51: During your life, how many times have you sniffed glue, breathed the contents of aerosol spray cans, or inhaled any paints or sprays to get high?

- A. 0 times
- B. 1 or 2 times
- C. 3 to 9 times
- D. 10 to 19 times
- E. 20 to 39 times
- F. 40 or more times

Q52: During your life, how many times have you used heroin (also called smack, junk, or China White)?

- A. 0 times
- B. 1 or 2 times
- C. 3 to 9 times
- D. 10 to 19 times
- E. 20 to 39 times
- F. 40 or more times

Q53: During your life, how many times have you used methamphetamines (also called speed, crystal, crank, or ice)?

- A. 0 times
- B. 1 or 2 times
- C. 3 to 9 times
- D. 10 to 19 times
- E. 20 to 39 times
- F. 40 or more times

Q54: During your life, how many times have you used ecstasy (also called MDMA)?

- A. 0 times
- B. 1 or 2 times
- C. 3 to 9 times
- D. 10 to 19 times

- E. 20 to 39 times
- F. 40 or more times

Q55: During your life, how many times have you taken steroid pills or shots without a doctor's prescription?

- A. 0 times
- B. 1 or 2 times
- C. 3 to 9 times
- D. 10 to 19 times
- E. 20 to 39 times
- F. 40 or more times

Q56: During your life, how many times have you taken a prescription drug (such as OxyContin, Percocet, Vicodin, codeine, Adderall, Ritalin, or Xanax) without a doctor's prescription?

- A. 0 times
- B. 1 or 2 times
- C. 3 to 9 times
- D. 10 to 19 times
- E. 20 to 39 times
- F. 40 or more times

Q87: During your life, how many times have you used hallucinogenic drugs, such as LSD, acid, PCP, angel dust, mescaline, or mushrooms?

- A. 0 times
- B. 1 or 2 times
- C. 3 to 9 times
- D. 10 to 19 times
- E. 20 to 39 times
- F. 40 or more times

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