EPIDEMIOLOGY OF PRESCRIPTION DRUG ABUSE IN ILLINOIS HIGH SCHOOL STUDENTS

BY

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DISSERTATION

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ABSTRACT

Prescription drug abuse has reached epidemic proportions and trends indicate that the number of adolescents who abuse these drugs will continue to increase. Every adolescent appear to be at risk and this epidemic does not appear to be defined by known risk profiles for substance abuse. Nearly one in every five 12th grade students used prescription drugs for non-medical reasons at least once in lifetime according to the Monitoring the Future study. This is a significant public health problem as prescription drug abuse in the adolescence can continue into the adult life and puts adolescents at risk of substance abuse and other comorbidities. The purpose of this study was to identify individual, family, school and community level factors responsible for the initiation and maintenance of prescription drug abuse behaviors in Illinois 12th grade students.

A cross-sectional study design was used with the secondary data on the 12th graders' prescription drug use from the 2010 Illinois Youth Survey. Multilevel logistic regression was performed to account for the multistage sampling and hierarchical structure of the data, using software such as HLM, STATA, and SPSS. Abuse of any prescription drug and of subclasses such as uppers, downers, steroids and other drugs were the dependent variables. Individual level variables such as age, gender, race, socioeconomic status, having clear college/future plans, other substance/over the counter (OTC) drug abuse, depression, gambling, family rules about alcohol and drug use, perceived peer drug use; school level variables such as the percent of -White students, students in the low socioeconomic status category, students reporting bullying, students reporting unsafe at school; and school district level variables such as community norms towards substance abuse, community activities, safety, location and availability of alcohol, tobacco and

other drugs (ATOD) were examined for their influence on prescription drug abuse in Illinois 12th graders.

Results indicate that Illinois 12th graders (11.4%) had a lower prevalence than the US prevalence (15.4%) in the year 2009. After adjusting for all the other variables in the multilevel logistic regression model, Illinois 12th graders with past year ATOD use (Odds ratio (OR): 6.095, 95% CI: 2.708,13.717), past year OTC drug use (OR: 6.081, 95% CI: 3.952,9.358), past year depression (OR: 2.381, 95% CI: 1.475, 3.844), and past year gambling (OR: 1.684, 95% CI: 1.069, 2.655) were found to have significantly higher odds of prescription drug abuse in 12th graders. Other individual level variables and all school/ school district level variables were found to be not significantly associated with prescription drug abuse in 12th graders.

Prescription drug abuse in Illinois 12th graders was significantly different from prevalence in US 12th graders and was found to be significantly associated with gender, past year ATOD use, OTC use, gambling, depression, and perceived peer drug use. Most of the variation in prescription drug abuse appears to be within the schools and school districts and only a little variation exists between schools / school districts. Despite some limitations, this study is significant as there aren't many studies done to recognize the frequent drug abuse epidemics in the subpopulations. This study contributes to the existing literature on prescription drug abuse by reporting the risk and protective factors operating at individual, school and community levels in Illinois 12^{th} grade students. Multilevel study design and statistical analyses also provide a framework for evaluation of prescription drug abuse prevention programs.

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CHAPTER 1
INTRODUCTION

Statement of the problem

Substance abuse in some form was always found in the history of mankind. Even the pre historic man abused drugs unknowingly (Sullivan & Hagen, 2002). In the modern times, although many of these substances are illegal, people still use them for many reasons. Adolescent substance abuse remains as an important public health problem and is a leading cause of preventable morbidity and mortality in the United States (CDC, 2012a).

While substances such as alcohol, nicotine, cocaine, heroin and marijuana are known to be commonly abused since a long time, the abuse of prescription drugs has rapidly increased to epidemic proportions among the adolescents (Friedman, 2006). In fact, prescription drug abuse has overtaken the abuse of many common illicit substances and is now second only to the abuse of marijuana (Johnston, O'Malley, Bachman, & Schulenberg, 2012). Initiation of prescription drug use for non-medical reasons seems to be associated with the initiation of other substance use with more than a third starting in the same year (SAMHSA, 2011). Prescription drug abuse poses unique challenges as abusers may not have the same amount of perceived risk and stigma associated as with illicit drugs. Also, these drugs are legal and can be more easily obtained than illicit drugs in many instances. Ironically, while noncompliance is a problem with the patients that should be taking the prescription drugs; those who abuse take these drugs for non-medical reasons.

The abuse of prescription drugs is hidden from the public view and severity of the problem is not yet recognized completely. Unlike the illicit substance abuse which was well publicized in the media with many personal stories of victims (Johnston, Bachman, Schulenberg,

& others, 2011) during the first drug abuse epidemic in the seventies, prescription drug abuse gains public attention only when the media highlights the stories of celebrity victims such as Michael Jackson, Heath Ledger etc. Current unfavorable economic conditions have resulted in a cut to the funding of anti-drug abuse programs and this combined with a decrease in the exposure to anti-drug ads in the media led to a decrease in the adolescents' perceived risk for many drugs. This situation has the potential to precipitate a second relapse of the drug abuse epidemic (Johnston et al., 2011).

Public Health Importance

In general, substance abuse behaviors are an important cause of morbidity and mortality. Tobacco use, for example, is the most common preventable cause of morbidity, mortality and disability ("CDC - Chronic Disease - Tobacco - At A Glance," n.d.). In spite of many advances, adolescent substance abuse remains as an important public health problem. More specifically, newer abuse patterns are emerging with more and more adolescents abusing prescription drugs. This problem of prescription drug abuse has already reached epidemic proportions (Sung, Richter, Vaughan, Johnson, & Thom, 2005) and can disrupt the lives of not just the students but also of their family, friends and everyone close to them.

Adolescents are particularly vulnerable to prescription drug abuse due to curiosity and tendency to experiment for recreational purposes. There is much at stake as adolescents determine the future of a country and therefore it is important to identify important factors that determine prescription drug abuse in the adolescents. Strengthening of protective factors and eliminating social factors leading to drug abuse is essential to secure the promise that every student's future holds. It is the collective responsibility of the community and the government to

make that happen. The public health importance of prescription drug abuse lies with the fact that these behaviors are completely preventable if targeted even before initiation and thus the related consequences are altogether avoidable. However, the early diagnosis of prescription drug abuse in the adolescents is difficult as this problem is hidden from public view. Therefore, unlike with many commonly abused illicit substances, it is difficult to develop specific programs to target prescription drug abuse.

Costs to the individual, family and society

Complications/Consequences

Adolescents do not have a good sense of judgment to analyze the pros and cons of their actions. Peer factors and adventurous nature of this age group makes them involve in high risk behaviors, complicating the already serious problem of drug abuse. However, even people who are aware of the harmful effects of such substances continue to involve in the abuse of illicit drugs.

Some of the long term consequences of prescription drug abuse include academic and health problems, higher truancy, drop out decisions, delayed or damaged physical, cognitive, and emotional development (Lennox & Cecchini, 2008). Nonmedical prescription opioid use results in decreased productivity and health care access and increased economic costs (Gilson & Kreis, 2009). Results from a study done with the "Monitoring the Future" data indicate that high school use and unemployment were associated with higher odds of substance abuse. Previous history of substance abuse, including abuse of prescription drugs, was found to significantly influence the drug abuse at 35 years of age (Merline, O'Malley, Schulenberg, Bachman, & Johnston, 2004). Thus, adolescents who abuse prescription drugs are at higher risk of other future substance abuse problems. In another study done with the data from a web-based survey on 1086 secondary

school students in 7-12 grades in the Detroit metropolitan area in 2005, it was found that medical/nonmedical users (17.5%) and nonmedical users (3.3%) had a significantly higher risk of illicit drug use and probable drug abuse (McCabe, Brower, West, Nelson, & Wechsler, 2007).

Another complication of prescription drug abuse arises due to the tendency of those who abuse these drugs to take them with some other drugs or alcohol. Alcohol is a good solvent for many prescription drugs and can increase the biologically available dose to the body and this additive or synergistic effect can be fatal (McCabe, Cranford, Morales, & Young, 2006). Also, when drug abusers develop tolerance, they take drugs in much higher doses beyond the usual therapeutic margins and that results in severe adverse effects including death (White & Irvine, 1999).

While there may be some theoretical support, although questionable, for adult substance abuse and "downward drift", in the case of adolescents the "downward drift" theory may not be applicable, as they stay with their parents and do not choose their neighborhood (Winstanley et al., 2008). However, prescription drug abuse in the younger population has the potential to eventually disrupt the nation's economy by influencing the future social productivity.

Emergency department visits

The number of deaths due to drug overdose, mostly due to prescription drugs, has increased more than three times. This corresponds to a three times increase in the sale of strong analgesics such as opioids, which are responsible for 75% of the prescription drug overdoses. The emergency department visits due to these drugs increased more than two times in just five years (CDC, 2011).

The misuse or abuse of prescription drugs resulted in 2.1 million or approximately half (45.1%) of all drug-related emergency department visits. Importantly, patients aged 20 or

younger accounted for 415,351 visits (9 %) of all drug-related ED visits. When compared to illicit drugs, the misuse or abuse of prescription drugs resulted in 88.3 more ED visits per 100,000 population during 2009 (DAWN, 2010). While there were no significant changes in the level of ED visits involving illicit drug use during 2004-2009, the number involving the misuse or abuse of prescription drugs increased by 45.4 % in those aged less than 20 years and by 98.4 % overall (DAWN, 2010).

Overdose due to opioid analgesics and sedative-hypnotics accounted for the majority of the ED visits during 2004-2009 (DAWN, 2010). Prescription opioid analgesic abuse has resulted in many ED visits and deaths, more commonly than due to illicit opioids such as heroin. There was a tremendous increase in the percentage of ED visits for narcotic analgesics such as Oxycodone (242.2 %), Morphine (133.3%), Hydrocodone (124.5 %) and Fentanyl products (117.5%) and sedative hypnotics such as Zolpidem (154.9 %), Alprazolam (148.3 %), Clonazepam (114.8%) and Lorazepam (104.3%) during this period (DAWN, 2010). This high number of ED visits due to prescription drug overdose translates into huge financial costs to society.

Statement of the purpose

The purpose of this study was to identify individual, family, school and community level factors responsible for the initiation and maintenance of prescription drug abuse behaviors in Illinois 12th grade students. Specifically, an attempt was made to understand the epidemiological patterns of prescription drug abuse in Illinois 12th grade students.

Significance of the study

Illicit substance use has been the focus of the majority of the previous studies. Although prescription drug abuse is not a new phenomenon in the adolescents, it has not attracted the attention of researchers until recently. Most of the studies on prescription drug abuse focused mainly on the risk or protective factors at a single level. This study takes factors operating at individual, school and community levels into consideration and will also examine interactions of factors operating at different levels. This study's design and statistical analysis will also provide a framework for evaluation of prescription drug abuse prevention programs. Despite some limitations, this study can thus contribute to the existing literature on prescription drug abuse.

Definitions

Prescription drug abuse is defined as "the intentional use of a medication without a prescription; in a way other than as prescribed; or for the experience or feeling it causes"(NIDA, 2012a). Therefore, if a student takes a prescription drug for unintended use/ pharmacological effect or seeks drugs obsessively and loses control, he /she is said to be abusing prescription drugs. When a student takes or drug prescribed for unintended use different dosage /frequency is said to be misusing a drug (NIDA, 2012a). However, there is no universal definition to determine a dosage or frequency of use that can be considered as drug abuse (Johnston et al., 2011). The definitions for prescription drug abuse, misuse or dependence can especially overlap and the conditions can coexist in the adolescents. Therefore, due to the severity of the harmful effects and epidemic nature of the problem, the term 'prescription drug abuse' was used to describe the adolescent non-medical use of prescription drugs in this study.

Conceptual/ theoretical framework for the study

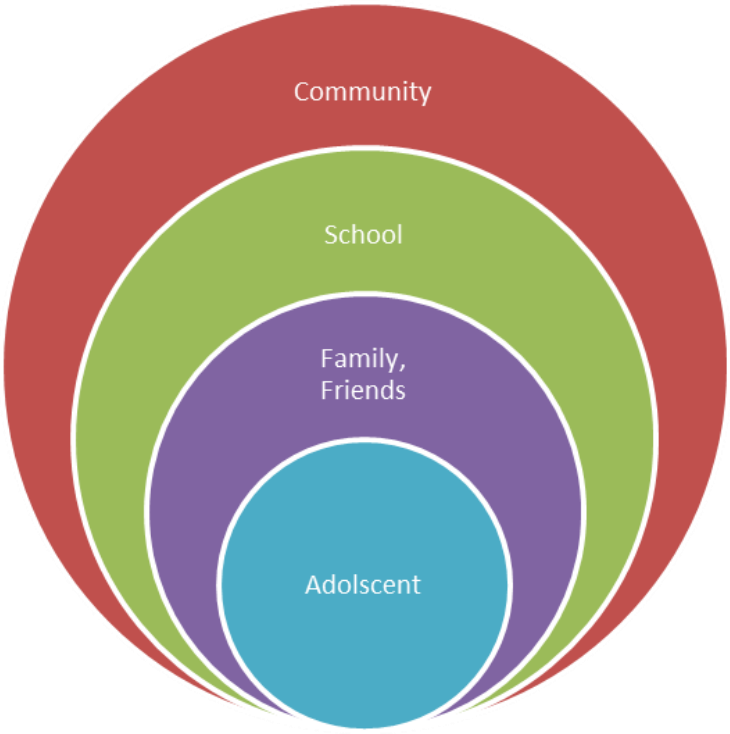
In spite of numerous theories on alcohol, tobacco or illicit substance abuse, there is a lack of specific conceptual or theoretical frameworks that can guide research in prescription drug abuse (Ford, 2008). There is no single conceptual theory that has all the constructs to completely explain prescription drug abuse. An individual's health behavior is not only determined by intrapersonal factors but also by interpersonal, and other social and environmental factors. Therefore, this study will attempt to understand the distribution and determinants of prescription drug abuse from an ecological perspective. In the following section, the socioecological model chosen for this study and a rationale for the choice will be discussed.

Socio ecological model

Social-ecological model (CDC & ATSDR, 2011) with four levels of influence for individual, relationship, community and societal factors was used as a conceptual framework for this study. Social-ecological model (SEM) can provide a theoretical framework to study the various risk and protective factors operating at different levels. In this model, individual is level one with genetic/biological, demographic and behavioral factors; relationship is level two with proximal social networks and interpersonal relationships that include friends and family; community is level three with schools and neighborhoods; and society is level four and includes cultural and policy factors. Factors that increase or decrease the risk of adolescent prescription drug abuse occur at each of these four levels. Factors operating at levels one and two can be considered as proximal determinants, whereas those in levels three and four can be considered as distal determinants.

Primary prevention of prescription drug abuse is possible only when these multilevel factors are addressed with specially designed multilevel prevention programs. Targeting both proximal and distal influences can bring long-term and sustainable results.

Eco social approach- Levels of Influence



The choice of socio ecological framework seems appropriate for this study because, ecological fallacy can result if inferences are made about an adolescent's risk of prescription drug abuse from an analysis that considers school or community level measures only and atomistic fallacy can result if group level inferences are made from individual level analyses (Krieger, 1994).

Summary

Adolescence is an age of many firsts and the tendency to experiment makes adolescents particularly vulnerable to substance abuse. While the abuse of illicit substances decreased to some extent, many adolescents are abusing prescription medications for non-medical reasons.

This problem of prescription drug abuse has already reached epidemic proportions and trends indicate that the number of adolescents who abuse these drugs will continue to increase. This epidemic does not appear to be defined by known risk profiles for substance abuse and every adolescent appear to be at risk. This is a significant public health problem as prescription drug abuse in the adolescence can continue into the adult life and puts adolescents at risk of substance abuse and other comorbidities.

While national studies such as Monitoring the Future (MTF) provide important information about trends of prescription drug abuse patterns over time, there aren't many studies done to recognize the prescription drug abuse epidemics in the subpopulations, which are known to occur frequently. This study made an attempt to contribute to the existing literature on prescription drug abuse by examining the risk and protective factors operating at individual, school and community levels and interaction between factors of different levels in the Illinois high school children.

CHAPTER 2
LITERATURE REVIEW

Introduction

In this chapter some important national studies that collect data about prescription drug abuse will be discussed in the beginning. Prescription drug abuse is the dependent variable for this study and therefore the prescription drug abuse epidemic is then described in terms of overall prevalence and trends, followed by a summary of national survey findings about the four subclasses of prescription drugs and their use by the 12^{th} graders. This is followed by a review of factors influencing prescription drug abuse behavior in the four socio ecological levels, including findings about the independent variables in the literature. An attempt is made to include some important studies and relevant theories that shed light on the way factors exert their influence on prescription drug abuse behavior in each sociological level. Finally, there is a summary of the common sources of prescription drugs identified in the 'Monitoring the Future' study and importance of literature review findings in terms of prescription drug abuse prevention.

There are mainly two important national studies that collect information about risky behaviors, including prescription drug abuse, in the adolescents. Monitoring the Future (MTF) is the largest national study on drug use in the school children and its findings appear to be the most relevant to this study. While Monitoring the Future collects data from approximately 50,000 students in 8th, 10th and 12th grades, National Survey of Drug Use and Health (NSDUH) collects data from approximately 67,500 non-institutionalized individuals aged 12 years and above. National Survey of Drug Use and Health (NSDUH) report highlights the important differences in the data collection procedures of the large national surveys and their implications on the survey findings (SAMHSA, 2011). Monitoring the Future collects data through in-school

and follow-up mail surveys, whereas computer-assisted interviewing (CAI) is used by NSDUH. Due to these differences, Monitoring the Future reports higher short term substance use rates than NSDUH but long term trends are similar. The external validity of studies based on data from National Survey on Drug Use and Health (NSDUH) data is greater than those studies based on data from 'Monitoring the Future' study (Ford & Arrastia, 2008).

Youth Risk Behavior Survey (YRBS) is another source which collects substance abuse data from students in 9th-12th grades on alternate years. The sample size is small but findings are similar to Monitoring the Future (SAMHSA, 2011). While these national surveys and studies based on national data provide important information about adolescent drug abuse, they often fail to recognize drug abuse epidemics and group differences in the sub populations (Kozel & Adams, 1986).

Characteristics of the drug abuse epidemic

Illicit drug use epidemic began in the sixties and has predominantly occurred in the younger generations since the seventies (Johnston et al., 2011). Cocaine initially and amphetamines later were the two most common illicit drugs other than marijuana that were abused by the 12th graders during this epidemic. Even with the relapse in the early nineties, no other age group seems to be affected as much as the adolescents. While the direction of the initial epidemic was from colleges to schools, the direction of the relapse phase was from schools to colleges. As a result, cohort effects were seen for various drugs abused by the adolescents (Johnston et al., 2011). The early phase of drug use epidemic, where the spread was from large to small communities, provides support for the theory of diffusion of innovations (Ferrence, 2002).

Prevalence and Trends

In general, USA has highest rates for many prescription drugs. According to CDC (2011), approximately 48% of the US population took at least one prescription drug in the past month during 2005-2008. According to the Monitoring the Future study, one in every two 12th grade students abused illicit drugs (49.9%), one in four used illicit drugs other than marijuana (24.9%) and more than one in five students (21.7%) used prescription drugs for non-medical reasons at least once in lifetime (Johnston et al., 2011).

Prescription drug abuse and adolescent preferences change frequently and therefore studying the trends is very important to discover emerging epidemics. The factors influencing trends can be different for the various prescription drugs abused. Monitoring the Future study began in 1975 and data collected during this year provide the baseline statistics for most of the 12th graders' commonly abused drugs (Johnston et al., 2011). As the data from this national study is similar to the Illinois Youth Survey, its important findings over the years are summarized here.

The prevalence of most commonly abused drugs continued to increase in the late seventies and eighties and reached a low in 1992. After 1992, there was an increase observed for many of these drugs. Differences in the abuse patterns by grade and by subgroups were observed. Age, cohort and period effects were also evident in the trends. Trends for most drugs were secular and had parallel lines for most age groups (Johnston et al., 2011). Cohort effects were evident during the 1990s with the trends diverging for the different age groups. In general, for all the demographic subgroups, any observed differences were especially highlighted during years of high prevalence and either narrowed or disappeared during years of low prevalence (Johnston et al., 2011).

‘Monitoring the Future’ study suggests that success in the illicit drug use prevention cannot be completely attributed to the primary prevention measures targeted at preventing initiation. Although it is very difficult to discontinue after previous drug use results in habit formation, even secondary and tertiary prevention measures played an important role in the decrease in the drug abuse prevalence. In general, non-continuation rates (i.e. abstinence in the past year after a previous use) rose with decrease and fell with increase in the use of a specific drug over a time period. While drugs such as steroids did not show any particular non-continuation trends, increase in the non-continuation was considered to be responsible for decrease in the use of sedatives such as barbiturates, and tranquilizers. Also, the peak initiation rates for various drugs are different. Due to a decrease in the number of higher grade students starting to use these drugs for non-medical reasons, a secular trend with a decrease in the average age of initiation was observed (Johnston et al., 2011).

Adolescents’ beliefs and attitudes appear to influence the prevalence of drug abuse and any changes in such perceptions over time influence the trends. Students who disapprove the use of these drugs or understand the associated risks are less likely to initiate prescription drug abuse, whereas those who abuse these drugs are less likely to disapprove or recognize and acknowledge the harmful effects. Monitoring the Future survey also collected data on perceived risk, perceived benefits, perceived availability and peer normative attitudes. These factors had a very important influence on the drug abuse trends. Thus, some of the trends probably provide support to the Health Belief Model constructs such as perceived susceptibility, perceived severity, perceived benefits, and perceived barriers at the population level. For example, aggregated data from the Monitoring the Future survey, show that high levels of perceived harmfulness and personal disapproval among the 12th graders were inversely related to drug abuse prevalence

(Johnston et al., 2011). Whereas, perceived harmfulness varies with the type of drug and 12th graders may have different beliefs for illicit and licit drugs. For example, the proportion for 12th graders with perceived harmfulness of regular use of amphetamines (64%) is much less than that of illicit drugs such as heroin (86%), cocaine (82%) and crack (84%). The proportion of students with perceived harmfulness for occasional or experimental use of prescription drugs such as barbiturates (28%) and amphetamines (41%) is also much less than for illicit drugs such as crystal methamphetamine (65%), heroin without a needle (64%), heroin (58%), cocaine (53%), PCP (52%), ecstasy (MDMA) (51%) and crack (50%). Anabolic steroids (59%) seem to be an exception but their abuse prevalence is much less when compared to other prescription drugs (p.347).

Also, nearly 90% of the 12th graders disapprove regular use of steroids (p.361). However, the 12th graders disapproval of experimental use is not very different for prescription drugs such as amphetamines and barbiturates (88%) when compared to illicit drugs such as heroin (94%), crack (90%), LSD (87%) and ecstasy (86%) (p.363). It is also interesting to note that a higher proportion of the 12th graders support restrictions on public use of drugs when compared to private use, both for and illicit drugs such as heroin (80% vs. 70%) and for prescription drugs such as amphetamines or sedatives (71% vs. 51%) (p.369). With regard to amphetamines and sedatives, this reflects a 6% decrease in the number of 12th grade students supporting restrictions on public use (p.369).

Perceived harmfulness can lead to personal disapproval that can further influence the norms in peer circles (p.351). In this regard, it is interesting to note that the levels of perceived harmfulness of experimental or occasional use of all drugs (except PCP) among 12th graders was highest during 1990–1991, just before 1992, the year of least prevalence for most drugs. The

prevalence of these drugs increased later with a decrease in perceived harmfulness after 1992 (p.351).

Prescription drug subclasses

Narcotics other than heroin

Narcotics other than heroin are an important group of drugs which are being increasingly abused in recent years. From an annual prevalence between 5.1% to 6.4% before 1992, and a low of 3.3% in 1992, their use has reached 8.7% in 2011 among 12th graders. Vicodin is an important prescription drug in this group and had an annual prevalence of 8.1% in 2011. Other opioid analgesics such as oxycodone (OxyContin) also have high abuse potential and as many as 1.9 million individuals use these drugs for nonmedical reasons. According to the Monitoring the Future Study (Johnston et al., 2012), 4.9% of 12th graders abused OxyContin at least once in the past year.

There was an alarming increase in the adverse effects reported from use of these drugs for non-medical reasons recently. For example, there was an increase of emergency department visits involving nonmedical use of narcotic pain relievers from 145,000 in 2004 to 306,000 in 2008. Overdose of opioid drugs such as OxyContin can cause miosis, hypothermia, bradycardia, hypotension, altered mental status and pulmonary depression (Aquina, Marques Baptista, Bridgeman, & Merlin, 2009). Mortality due to prescription opioids overdose, usually resulting from pulmonary depression has increased four times in the last thirteen years. Adolescents sometimes take even oral formulations in intravenous form and share needles. This practice often puts them at risk of HIV and other infections (NIDA, 2012b). Cicero et al. (2011) reported higher odds of using alternate routes of administration and reusing non-sterile needles in those with prescription opioid abuse.

Downers

This group includes sedative hypnotics and other central nervous system depressants such as barbiturates, benzodiazepines and opioids. The annual prevalence of sedative abuse among 12th grade students was 11.7% at the beginning of the 'Monitoring the Future Study' in 1975 and this gradually decreased to 2.9% in 1992. However, resurgence in the use of these drugs was observed and their annual prevalence increased to 7.6% in 2005 and was recorded at 5% in 2010 (Johnston et al., 2011). Barbiturates, an important group of sedatives, followed a similar trend with an annual prevalence of 10.7% in 1975 a low of 2.8% in 1992 and an increase to 4.8% in 2010. Tranquilizer use by 12th graders showed some dramatic trends with their use decreasing to nearly one fourth of the peak use by 1992. However, like with many other commonly abused drugs, their use again increased after 1992 to an annual prevalence of 7.7% in 2002 and was at 5.6% in 2010. Recent Monitoring the Future Study (Johnston et al., 2012) results show that, among 12th graders 4.3% abused barbiturates and 5.6% abused tranquilizers at least once in the past year.

The effects of downers are similar to alcohol as they also depress the central nervous system. They have a synergistic effect when taken with other depressant drugs or alcohol. In a study done on 1,044 students in 7^{th} to 11^{th} grades, those with high anxiety were found to have abused downers, uppers, alcohol and hallucinatory drugs more frequently (Ste-Marie, Gupta, & Derevensky, 2006). Sudden cessation of usage in those who abuse these drugs can result in severe withdrawal symptoms such as seizures. Although the abuse of drugs such as barbiturates has decreased considerably, depressants in general can be addictive like opioids and in high doses can result in depression of the pulmonary function. Although there is an increase in the initiation of sedatives, they haven't reached the peak levels observed in the past (Johnston et al., 2011).

Uppers

Attention-deficit hyperactivity disorder (ADHD) and narcolepsy are two common therapeutic indications for stimulant medications. Other than for medical purpose, stimulants are abused for a variety of reasons including performance enhancement because of their effects such as increased focus / attention, increased alertness, weight loss due to appetite suppression or in parties as recreation drugs due to their rapid effect on the dopaminergic system (NIDA, 2012c).

Adverse effects of this group of drugs include anxiety, paranoia, hyperthermia, arrhythmias and seizures. CDC (2012b) reports that approximately 9.5 % percent of children aged 4–17 years were diagnosed with ADHD in the year 2007 and many of these school age children were on stimulant medication. According to the Monitoring the Future Study (Johnston et al., 2012), common stimulants abused by 12th graders at least once in the past year include amphetamines (8.2%), Ritalin (2.6%), Adderall (6.5%) and Methamphetamine (1.4%). The abuse of stimulants appears to be decreasing after the peak use in the nineties. However, less than one fourth (24%) of the 12th graders reported that none of their friends used amphetamines in 2010 (Johnston et al., 2011). Between 1976 and 1981, there was a 10% increase in the annual prevalence and 300% increase in the current daily use of amphetamines among 12th graders. The peak amphetamine use was documented in the year 1981 and this was followed by a 67% or greater decrease in the annual prevalence, 30-day use, and current daily use during 1982-92.

Monitoring the Future study data for these years showed that the prevalence of some stimulants decreased in recent years as a new class of stimulants was favored by the adolescents. The type of stimulant abused changed with time as Benzedrine, Methedrine, and Dexedrine were popular in the eighties but Ritalin, Adderall, and Concerta are more popular recently (Johnston et al., 2011). Thus, newer stimulants are being preferred and are replacing the older drugs. For example, increase in the Adderall, and Concerta abuse may have been responsible for the recent

decrease in the annual prevalence of Ritalin from 3.9% in 2004 to 1.5% in 2010 (p. 413). According to the Diffusion of Innovations theory, this can be considered as an example of "relative advantage" of the new drug and "compatibility" with the desired effects of the old and replaced drug (Ferrence, 2002).

Steroids

Abuse of anabolic androgenic steroids is not limited to athletes and is not an uncommon practice in the general population including school students. According to the 'Monitoring the Future' Study (Johnston et al., 2011), for every 200 students, nearly one in 8th grade, two in 10th grade, and three in 12th grade admitted abusing anabolic steroids at least once in the past year. The annual prevalence of anabolic steroids among 12th graders was 1.9% in 1989 and reached a low of 1.1% by 1992. However, their use again increased to 2.5% during 2001-2004 and reached to an annual prevalence of 1.2% in 2011.

Although, anabolic steroids are commonly abused for their athletic performance enhancing actions resulting from increased muscle mass and strength, there are many adverse effects such as testicular atrophy with suppressed hormone and sperm production, impotence in males and similarly atrophy of uterus and breast and irregular menses in females, hypertension (NIDA, 2012b), increasing the bad cholesterol and decreasing the good cholesterol, predisposing to hypercoagulability, diabetogenic effect due to decreased glucose tolerance, muscle or tendon rupture, dermatological problems such as thinning of skin, acne, carcinogenic effect with increased risk of prostate cancer, liver cancer, and Wilm's tumor and suppressed immunity predisposing to increased susceptibility to infections. Abuse in school children may especially result in early closure of epiphyses thus limiting their growth (Maravelias, Dona, Stefanidou, &

Spiliopoulou, 2005). In addition to these drugs can cause psychiatric problems such as psychosis, aggression and mood disorders (Kanayama, Hudson, & Pope Jr, 2008).

Ketamine

Ketamine is a dissociative anesthetic and is being abused for non-medical reasons since the seventies (Dotson, Ackerman, & West, 1995). Adolescents tend to abuse ketamine as a party drug or at clubs. It's dose dependent effects range from feelings of detachment and hallucinations, impaired attention and learning ability, impaired motor function, delirium, amnesia, hypertension, and severe pulmonary complications (NIDA, 2012d).

According to the Monitoring the Future Study, 0.8% of 8th graders, 1.2% of 10th graders and 1.7% of 12th graders abused Ketamine at least once in the past year (Johnston et al., 2012). Negative publicity in the media kept the use of other club drugs such as Rohypnol or 'date rape" drug low.

Factors influencing prescription drug abuse

There are many reasons for an increase in the prescription drug abuse prevalence observed in recent years. Most important is the increased availability of the prescription drugs in the community, mainly due to an increase in the number of prescriptions. For example, there was a 900% increase in stimulant prescriptions and 278% increase in opioid analgesic prescriptions during the period 1991-2010 (NIDA, 2012b). Easy availability of prescription drugs may thus have an important role to play in communities with high rates of substance abuse. For example, physicians have easier access to prescription drugs and are therefore more likely to abuse them. Therefore, availability may determine increased use, misuse or abuse of products that can influence health adversely. Easy availability of Pepsi cola drinks at home and school leads to

increased consumption and leading to the problem of obesity (Kassem, Lee, Modeste, & Johnston, 2003) and in a similar way, adolescents may abuse prescription drugs because of easy availability at home. Thus, easy access to family members' prescription drugs at home is of great concern.

Contrary to expectations, adolescents misuse prescription drugs mainly for pharmacological indications than for recreational purposes or for some unintended spurious benefits (Boyd, McCabe, Cranford, & Young, 2006). They may be seeking pharmacological solutions for physical or mental health problems. For example, sedatives or tranquilizers may be abused as a means to cope with pressures or anxiety. Steroids and stimulants may be used for performance enhancing effects. Just as some adolescents smoke to lose weight, even prescription drugs such as stimulants may be abused for weight loss due to their appetite suppression effect. Addiction to prescription drugs like stimulants can result from their effect on dopaminergic system in the brain.

The popularity of some of the commonly abused drugs can be explained by their pharmacological effect. For example, the proportion of students reporting moderate or very high duration of drug high varies with the drug- tranquilizers (60%), narcotics other than heroin (55%) and amphetamines (43%) (Johnston et al., 2011). Social or recreational use can influence the trends of drugs such as amphetamines and tranquilizers. Although many students abuse prescription drugs, especially psychotherapeutic drugs, for such a stimulant or depressant effect on consciousness, many students do not report obtaining an anticipated high. This makes the emerging epidemic of prescription drug abuse even more intriguing.

Adolescents may wrongly assume that prescription drugs are safer than illicit drugs like heroin (Johnston et al., 2011). Because of this false notion about the safety of the prescription

drugs, these drugs are often abused for non-medical reasons and the harmful effects in the abusers are not easily identified. Disabling withdrawal symptoms, like in the case of opioid drugs or even steroids, may be a reason for some adolescents to continue abusing the prescription drugs. Prescription drugs are also relatively cheaper than illicit drugs and with relatively less parental restrictions when compared to illicit drugs. There is no moral stigma attached like with illicit drugs and their use is thus "compatible" and socially acceptable. Therefore, "trialability" of prescription drugs can be considered as high because of the low perceived risk (Ferrence, 2002).

Important considerations about substance abuse methodology

From an epidemiological perspective, the etiology of prescription drug abuse is multifactorial and complex and therefore modern theories like the eco-epidemiological theory (Krieger, 2001) can help to explain the epidemiology of adolescent prescription drug abuse using a sociological framework. The foundations for such a population based approach to disease prevention were laid out by epidemiologists such as Geoffrey Rose and Marvin Susser.

Substance abuse in general is thought of as a personal weakness, holding the adolescent completely responsible, and victim blaming is often the result of such a perspective. Such societal perceptions of adolescents who abuse prescription drugs can be explained by the attribution theory (Preyde & Adams, 2008). While the individual level health behavior theories hold the individual responsible for his/her actions, an adolescent's prescription drug abuse behavior should not be studied in isolation, as genetic, biologic, school and community level factors can all be determinants. While individual level behavioral research is still significant and forms the basis of many prevention programs, there is certainly a need for a more comprehensive

approach to understand the social and ecological determinants of prescription drug abuse i.e. both proximal and distal determinants should be examined.

Many of the modern ecological theories are derived from the ecological systems theory (Bronfenbrenner, 1992, 1997; Bronfenbrenner & Morris, 2007), which explains the influence on a child in terms of five spheres of influence- micro (family, school, peer groups), meso (interactions between relationships), exo (neighborhood), macro (culture) and chrono (time changes) systems. McLeroy, Bibeau, Steckler, & Glanz (1988) proposed a modified version of the social ecological model, similar to the conceptual model of this study, that considers influences on health behavior at intrapersonal, interpersonal, community, institutional and public policy levels. Various agencies have adopted the socio ecological model to suit the needs of their programs.

For the purpose of this study, a modified version of the socioecological model, advocated by the Center for Disease Control (CDC & ATSDR, 2011), seems to be the most appropriate. In general, ecological models theorize that specific factors operating at multiple levels interact and influence human behavior (Sallis, Owen, & Fisher, 2008). These models are behavior-specific and were applied successfully for tobacco use in the past and currently for health behaviors related to physical activity, obesity and diabetes. However, ecological models are robust and can be adapted for adolescent prescription drug abuse behavior (Sallis et al., 2008).

Unlike individual level health behavior theories that focus solely on changing the behavior of the individual, ecological models provide conceptual support for changing the behavior of the whole population. Ecological models also consider multi-level interventions as the best approach for a sustained, long term population level behavioral change (Sallis et al., 2008). For example, the success of smoking prevention programs has been attributed to a

comprehensive approach that considered genetic, physiological, psychological and social factors, the influence of family rules, taxes and policies, and advertising in the etiology and the implementation of multilevel programs addressing these factors (Sallis et al., 2008).

Prescription drug abuse prevention measures targeting the adolescent behavior only will not be successful. Therefore, distal risk factors in the school and community such as easy availability of prescription drugs at home or in the neighborhood should also be considered. Based on the principles of an ecological model, these distal factors should actually be addressed before targeting adolescent behavior (Sallis et al., 2008). However, influences of individual, school, and community factors and their influence on prescription drug abuse will not be easy to address in the prevention programs.

Levels of influence

Factors influenced by the intra-individual characteristics or inter-individual relationships such as family and friends constitute the proximal risk or protective environment. Whereas, the school and community level factors comprise the distal risk or protective environment. Whether prescription drug use can be considered as a social problem like illicit drug abuse may be known only when future studies incorporate examine social factors consistently in the analytic model. Although desirable, due to the study design and limitations of the secondary data, level one genetic/biological and level four policy factors this proposed study will not be considered for this proposed study.

Level one factors- Intrapersonal

This level has been the target for most of the drug abuse etiological research and prevention programs. Health belief model, theory of reasoned action, problem-behavior theory

and substance abuse specific theories such as gateway theory can provide insight into the role of individual level factors on prescription drug abuse.

According to the gateway theory of drugs (Kenkel, Mathios, & Pacula, 2001), adolescents first experiment with less harmful and legal drugs before gradually shifting towards more harmful and illicit substances. The stepping-stone hypothesis, multiple-stage progress theory and the gateway theory are also based on the concept that the adolescent pass through stages and slowly proceed to use hard drugs (Preyde & Adams, 2008). Whether prescription drugs are gateway drugs to illicit drugs is not known but studies have shown association with illicit substance abuse.

Problem-behavior theory has been successfully used to explain drinking and other problem behaviors. According to this theory, the probability of a problem behavior such as substance abuse is a function of interaction between the individual and the environment (Jessor, 1987). Individual level and the environmental level risk and protective factors can have direct and indirect effect on problem behavior. This theory can possibly explain recreational use of prescription drugs abuse but as the most common reason for non-medical use of prescription drugs is their pharmacological effect its applicability in this case is uncertain.

Theory of Reasoned Action (TRA) proposed by Fishbein (1979) can be applied to planning interventions against illicit drug abuse (Martin Fishbein & Middlestadt, 1987). According to this theory, prescription drug abuse behavior of the adolescents can be considered as determined by the intention to take the drugs for non-medical reasons. This intention is further shaped by the attitudes of the adolescent towards such a behavior and subjective norms. The relative importance of attitudes or subjective norms can be behavior and population specific and understanding their relative importance is of primary importance in planning interventions

(Martin Fishbein & Middlestadt, 1987). An adolescent's drug related attitudes are determined by the outcome expectancies and evaluation of the outcome. Whereas, an adolescent's beliefs about what significant others think about involving in the prescription drug abuse behavior and a motivation to comply with such peer or social pressures shape the subjective norms. Before an attempt is made to change the prescription drug abuse related attitudes and subjective norms in the adolescent population, the salient beliefs responsible for such a behavior should be first identified (Martin Fishbein & Middlestadt, 1987).

Laflin, Moore-Hirschl, Weis, & Hayes (1994) consider the theory of reasoned action to be more useful than the theory of planned action for prediction of drug use behaviors. In their study, drug use related attitudes and subjective norms were found to be related to drug/alcohol use in this study. According to the authors, perceived behavioral control (PBC) or self-efficacy cannot predict most of the volitional drug/alcohol use but can explain if it is non-volitional and occurs as a result of peer pressure or dependence. Therefore, trying to increase self-efficacy in prevention programs is not of much use (Laflin et al., 1994).

Based on the diffusion model of innovations, an adolescent may initially gain "knowledge" about a prescription drug and develop a positive opinion about it by "persuasion". He/ she may then make a "decision" to adopt the new prescription drug and "implement" that decision. Peer approval and pharmacological effects of the prescription drug may result in "confirmation" of the abuse. The internal process of analyzing positive and negative outcomes before taking an action is also theorized in the health belief model (Ferrence, 2002). Adolescents may or may not abuse prescription drugs depending on their degree of "susceptibility". Those exposed to prevention messages and do not initiate prescription drug abuse can be considered as inoculated. Adolescents abusing new prescription drugs can be classified as innovators, early

adopters, early majority, late majority and laggards, depending on their stage of adoption (Ferrence, 2002).

Demographic factors

Gender

In general, males have a higher prevalence of use for many drugs and the higher rates have been consistent across many years (Johnston et al., 2011). The annual prevalence of "any illicit drug" use decreased from 49% in 1975 to 29% in 1992 but again increased to 41% by 2010 in the 12th grade males. Females had an overall lower prevalence but showed similar trends with a decrease from 41% in 1975 to 25% in 1992 and an increase to 35% in 2010. If marijuana use is excluded, the prevalence of other drugs was found to be slightly higher in the lower grade females (Johnston et al., 2011).

Earlier maturity may be responsible for higher use of drugs such as amphetamines among the 12th grade females in the past but latest trends indicate that there isn't much difference in the lower grades. Also by 12th grade, males had higher prevalence of illicit drug use other than marijuana (Johnston et al., 2011). This higher use by 12th grade males is observed for many commonly abused prescription drugs such as steroids (3x-6x), androstenedione (>3x), Ritalin, ketamine (>2x), and OxyContin (1.5x-2x). Males also try many different types of drugs and have higher frequency of use.

As with all other sub group differences, the observed between group differences were highest during periods of high prevalence and vice versa. The commonly abused drugs may vary by grade. For example, drugs such as inhalants are popular in lower grades but not in the 12th grade (Johnston et al., 2011).

Race/Ethnicity

Racial differences exist for drug use with differences in rates as well as the types of drugs commonly abused. According to the Monitoring the Future survey (2010), the lifetime, yearly, monthly, and daily prevalence rates were lowest for African-American students in the 8th, 10th, and 12th grades for almost all drugs and the lifetime and annual prevalence rates of many drugs was highest for 12th grade White students (Johnston et al., 2011). Although Hispanic students have highest prevalence of many drugs in the lower grades, White students in the 12th grade have highest prevalence for most commonly abused prescription drugs such as narcotics other than heroin, amphetamines, barbiturates and tranquilizers (p. 277).These patterns have been consistent for many years.

As with most commonly abused prescription drugs, 12th grade White students have the highest prevalence for narcotics other than heroin, OxyContin and Vicodin and African American students have the lowest prevalence and these subgroup differences are increasing in recent times (p. 193). Recent trends indicate that the Hispanic and African American 12th graders' abuse of Ritalin has increased. Irrespective of the racial group, trends for the abuse of downers such as barbiturates and tranquilizers among 12th graders have begun to show a decline. The subgroup differences for steroids have almost disappeared as White and Hispanic students' abuse has decreased, whereas abuse among African-American students has increased after 1999 (p. 195).

Socioeconomic status (SES)

The results have not been consistent in the different studies but no social stratum is immune to the drug abuse problem. For example, parental education is used as a proxy for the students' family socioeconomic status (SES) in the Monitoring the Future survey (Johnston et al.,

2011). Substance abuse appears to have a strong association with parental education among the White students, but has a weak association among African-American and Hispanic students. Racial and ethnic SES differences complicate the observed 8th grade negative ordinal relationship between SES level and the annual prevalence of many drugs. Such a relationship is not seen for the 12th grade students, probably due to the phenomenon of "catching up" or due to differential rates of dropping out (Johnston et al., 2011). While the lowest SES stratum had highest prevalence for Ritalin and tranquilizer use in the lower grades, OxyContin and Vicodin use was found have such an inverse relationship with SES in all the three grades (p. 188). Adolescents with public health insurance were found to be more likely to indulge in substance abuse (Winstanley et al., 2008).

Genetic/ biological

Many studies have been conducted to identify the genetic risk of drug abuse. In a recent study done in Sweden on 18,115 adopted children born during 1950-1993 and their biological/adoptive parents and siblings, it was found that individuals with genetic risk factors for drug abuse are particularly vulnerable to environmental negative influences such as parental divorce / death, criminal records, psychiatric problems and alcohol or drug abuse in the family. Even children who were adopted had a higher odds of drug abuse if their biological parents abused drugs (OR: 2.09; 95% CI: 1.66-2.62) (Kendler et al., 2012).

Recently, there has been an increased focus on research to unravel the neurobiological mechanisms of addiction. For example, Caplan, Epstein, Quinn, Stevens, & Stern (2007) conducted research on drug addiction and concluded that it is initiated by drugs causing extracellular release and direct action of dopamine in the nucleus accumbens shell of the brain.

Whereas, the chronic use of drugs negatively influences the impulse control and decision making via action on prefrontal corpus striatum and results in recurrent craving. Thus, a vicious cycle of drug use and addiction is initiated by dopaminergic mechanisms by disruption of neuro-adaptive processes and alteration of the reward system.

Another researcher West (2001) also considered addiction as a problem with motivational system and reward-seeking behavior, which results in perceived need and cravings leading to habit formation, dependence or intoxication. Adolescents many times do not have good decision making ability and addiction impairs this further.

Other individual level factors identified in various studies

While the prescription drugs are being abused since a long time, the risk profile of the abuser has not been completely elucidated. However, the following studies identified some important correlates. In a study done with data from the National Survey of Child and Adolescent Well-Being, the point prevalence (13.5%) of psychotropic medication use in children in child welfare system is nearly two to three times higher than that of children in the community. Higher use is seen with older age, males, Caucasians, history of physical abuse, public insurance, and borderline scores on the internalizing and externalizing subscales of the Child Behavior Checklist. Lower use is seen in African-Americans and Latinos, and in those with a history of neglect (Raghavan et al., 2005).

In another study done by Levine & Coupey, (2009) on 849 rural 12th grade students, it was found that males had higher odds (1.9) of prescription drug abuse when compared to girls and marijuana users had higher odds (3.8) when compared to nonusers. Over all, these students

reported nearly 3 times (34%) higher prescription drug abuse than national average (12%). Whereas, a study done by Schepis & Krishnan-Sarin (2009) using National Survey on Drug Use and Health data from the years 2005 and 2006 found that prescription abuse has increased over the past decade among adolescents and there are gender and racial/ethnic differences observed in the sources from which the drugs are obtained and usage patterns.

Harrell & Broman (2009) made similar observations in their study on prescription drug abuse in young adults. They found that age, alcohol use, marijuana use and delinquent behavior among Whites and inhalant use, delinquent behavior and maternal warmth among Hispanics were associated with increased prescription drug abuse. Whereas, marijuana use among Hispanics and religious attendance among Blacks were found to be inversely associated with prescription drug abuse. Overall, younger age, lower education, delinquent behavior and other substances abused such as alcohol, marijuana and inhalants were found to be significantly associated with increased prescription drug abuse. This finding is corroborated in another recent study which found that delinquent behavior, substance abuse and PTSD were associated with non-medical use of prescription drugs (McCauley et al., 2010).

There may be a difference in the reasons for prescription drug abuse by age group as stressful college environment and high academic demands may be the reason why college students were found to be more likely to use prescription stimulants for non-medical reasons such as to stay awake at night to study. College students may also use these stimulants to stay awake to party for more time. Since college selection process has become very competitive, whether school students also use these stimulants as study aids have to be studied (Arria et al., 2008).

Having clear academic plans seem to have a protective effect, as college-bound students reported lower rates of illicit drug use. Non-college bound students had higher usage of Vicodin, OxyContin, Ritalin, sedatives and tranquilizers. Steroid use was also much higher among non-college bound students. However, a higher decrease is observed in the non-college bound students after 1992. Non-college-bound students had higher use of Vicodin, OxyContin, Ritalin, barbiturates and tranquilizers (Johnston et al., 2011). Students who were not sure of completing college education were at higher risk of drug abuse (p. 177). However, recent decrease in the drug use was more prominent in the non-college-bound students (p. 175).

The association between gambling and substance use has been the subject of many previous studies. Unlike gambling behavior that starts in adulthood, adolescent gambling is more likely to be a problem behavior (Welte, Barnes, Tidwell, & Hoffman, 2009). Therefore, past year gambling was included as a predictor of 12th graders' prescription drug abuse in this study along with other problem behaviors such as ATOD use in the past year.

In a study done by Jacobs (2000), it was estimated that 15.3 million adolescents aged 12-17 years in US and Canada were involved in gambling and approximately 14.8% of these experienced related adverse consequences. In another recent study done by Gupta et al. (2012), Canadian adolescents were found to indulge in gambling activities both at home and in school and were thought to have two to four times higher lifetime prevalence than adults.

Gambling on the internet is a more recent phenomenon that has become popular rapidly. Adolescents can access the gambling websites through social networks and even on their cell phones. This growing problem is a cause of concern due to the ease with which adolescents can access internet gambling websites in spite of underage restrictions (Griffiths & Wood, 2007). In a study done by Brunelle et al. (2012) on 14 to 18 year old Quebec students (n = 1870), when

compared to those who do not gamble or gamble on internet, problematic substance use and delinquency were found to be higher in students who gamble on internet. Pathological gambling was found to be more likely in the students who gamble on the internet.

In a study done by Duhig, Maciejewski, Desai, Krishnan-Sarin, & Potenza (2007) on adolescents aged 16-17 years using data from the Gambling Impact and Behavior Study, past year gambling was found to be associated with moderate to high-frequency drinking. Abstainers/low-frequency drinkers, who gambled in the previous year, were found to have increased odds of drug use. In another study done with data from the Gambling Impact and Behavior Study, Liu, Maciejewski, & Potenza (2009) concluded that a common underlying mechanism such as impulse dyscontrol can explain the co-occurrence of recreational gambling and substance abuse. The authors suggest a two way mechanism by which excitement/stress from gambling leading to substance abuse and disinhibition from substance use leading to gambling.

Level two factors- Interpersonal- Relationships (friends and family)

Focus on interpersonal relations is important because an adolescent's behavior is dependent on the social environment. It appears that friends have a greater influence on drug use related attitudes than parents for the 12th graders. Probably because of the desire to fit into the group, drug use related beliefs and attitudes of the 12^{th} graders were found to be similar to their peers (Johnston et al., 2011). Unlike drug related family norms which were always conservative, peer norms changed with time and were drug specific and were also different for different degrees of use. However, parents themselves may not know much about prescription drug abuse

and may not feel it necessary to discuss about it as they usually do with illicit drugs (McCabe, Boyd, & Young, 2007).

Majority of the peer norms were conservative and more than 90% of the 12th graders reported that their friends would disapprove even experimenting with both illicit and licit drugs in 2010 (Johnston et al., 2011). Almost half (47%) of the 12th graders reported that they had exposure to their friends use of "any illicit drug other than marijuana" during the prior year. This is a worrying fact as an adolescent's drug abuse behavior is thought to be acquired by a social-learning process through observation of their peers (p. 413). A 12th grade student will be more likely to abuse drug if peers also abuse, more likely to make friends use if the student abuse drugs and more likely to seek and remain in circles that abuse drugs (p. 411).

Not staying with one or both parents increases the risk of adolescent substance abuse (Winstanley et al., 2008). Parenting styles such as low care and overprotection influenced excessive drinking behaviors in school students (MacCall et al., 2001). Schinke, Fang, & Cole (2008) did a study done on 781 adolescent girls and their mothers and found that use of alcohol, prescription drugs, and inhalants and girls' after-school destinations, body images, depression, best friend's substance use, maternal drinking behavior, mother-daughter interactions, and family norms surrounding substance use were all related. Although peer pressure from friends is an important determinant of substance abuse, Preyde & Adams (2008) concluded that adolescents are influenced mostly by family, based on the constructs in social cognitive theory. Family therefore has a large influence on adolescents and dysfunctional family environment will put adolescents at high risk of substance abuse. Strong family and school bonds appear to protect adolescents from nonmedical prescription drug use (Ford, 2009). In addition to peer drug use,

adolescent drug use is both directly and indirectly influenced by family factors such as parental attitudes, parental monitoring, bonding with parents and drug use of siblings (Bahr, Hoffmann, & Yang, 2005).

Initiation of prescription drug abuse under the influence of friends, class mates, family and role models can be considered as similar to the spread of a communicable disease through person-to-person transmission (Korff, Koepsell, Curry, & Diehr, 1992). Refusal skills and self-efficacy are therefore particularly important in the development of a strong character to resist such high pressure negative environment. Peer leaders may influence the adoption of a new prescription drug in the group. This is important as studies have shown that adolescents may not initiate prescription drug abuse until such a practice is initiated in the group. Such a modeling of behavior by observing significant others is also supported by social cognitive theory.

An adolescent's conformity to the peer groups' drug habits as a result of the desire to belong is well documented in the literature. An adolescent may start abusing a new drug only after significant others in their close social circle indulge in it (Ferrence, 2002). In a study done by Ford (2008), use of alcohol and other drugs was found to be the most important determinant of nonmedical prescription drug use in the past year. Substance use favorable attitudes of friends and family were also found to be significant. Social learning theory was found to be useful to explain adolescent prescription drug abuse in this study.

Bandura's model of reciprocal causation, as proposed in the social cognitive theory (Bandura, 1989), is probably best suited to explain the influences of level two and three factors on the adolescent prescription drug abuse behavior. Social cognitive theory can explain the influence of friends and families and involves triadic reciprocal determinism, where there is a

bidirectional interaction between the environment and the individual behavior, cognition and other personal factors.

Bandura (1999) considers substance abuse as a social problem and does not consider individuals as “powerless” victims succumbing to drug abuse. In this theory, undue importance is not placed on either the individual or the environment alone. Indeed, Bandura (1989) states that “people are both products and producers of their environment”. Therefore, according to his social cognitive theory, an adolescent’s own prescription drug abuse behavior is responsible for the environment that results from his/her choices or actions (Bandura, 1989).

Modeling influences of significant others are an important factor that determines an adolescent’s behavior. An adolescent can learn prescription drug abuse behavior vicariously just by observing such a behavior and the resulting experiences in the social environment. Substance abuse behavior is most importantly determined by perceived self-efficacy and therefore low self-regulatory efficacy and positive outcome expectations play an important part in succumbing to the internal pressures (Bandura, 1999).

While “generation forgetting” due to lack of vicarious learning by observing the effects of abuse in significant others was thought to be responsible for the resurgence observed with certain illicit drugs (Johnston et al., 2011), prescription drug abuse poses a different threat as private use is more common than public use and the negative consequences are also not evident until late.

Level three factors- Community (schools and neighborhoods)

These distal factors can increase or decrease an adolescent's risk of prescription drug abuse depending on the adolescent’s innate resistance to social pressures. An adolescent's risk of prescription drug abuse can be considered as high, if there is low "immunity" in the social

environment i.e. if there are many susceptible individuals, who abuse or are at risk of substance abuse in the family, school or community (Korff et al., 1992). Diffusion theory compares the spread of an epidemic of illicit drug use to a communicable disease that spreads through contact in social networks, schools and neighborhoods (Ferrence, 2002).

In a study done on substance abuse in 12th grade students in Utah, Social Ecology Model was applied and it was found that family and school climate latent variables predicted self-efficacy and school bonding. The study concluded that intrapersonal (self-efficacy), interpersonal (school bonding and peer relations) and social environmental (family and school climate) factors should be addressed in substance abuse prevention programs (Kumpfer & Turner, 1990).

Another study that found support for the influence of school and community contextual factors on adolescent substance use was done by Mayberry, Espelage, & Koenig (2009) on a sample of 14,548 12th grade students from Dane county, USA. Positive school climate and a positive sense of community had a protective effect against adolescent substance abuse in this study. Further, a positive perception of the community was found to have a protective effect against negative influences from friends and family. However, school climate did not have a moderating interaction with these variables. Adolescent participation in school/community-based organizations leads to an increase in their social capital and can decrease the risk of substance abuse, possibly via a moderating effect of the supervisors and rules for participation (Winstanley et al., 2008).

It is important to study if the abuse of prescription drugs is related to the availability of other substances such as alcohol in the local community as in general substance abuse, like many other health problems, can be linked to social factors. Drug abuse prevalence appears to be dependent on the availability of the drug in the community and this in turn parallels the 12th

graders' perceived availability of the drug. For example, the 12th graders' perceived availability of commonly abused drugs such as the narcotics other than heroin (54%), amphetamines (44%), barbiturates (37%), steroids (27%), and tranquilizers (18%) closely follows their actual prevalence (Johnston et al., 2011).

For the most part, drug use trends also follow changes in the perceived availability of drugs as is evident from a decline in the use of amphetamines, barbiturates and tranquilizers over time (Johnston et al., 2011). For example, an increase in the prevalence of narcotics other than heroin followed an increase in the perceived availability during 1978-1989. A 20% decrease in the anabolic steroid availability by 2010 was also paralleled by a sharp drop in the prevalence as well. However, unlike for other drugs, increased cocaine use was thought be responsible for the decrease of amphetamine use, rather than any changes in the perceived risk or perceived availability (p. 424). However, even with a 75% decrease in the perceived availability of tranquilizers during 1975-2010, their use has been increasing for the most part after the period of lowest use in the 1990s (p. 420). Not surprisingly, 77% of the 12th grade students who abuse drugs perceive easy availability (p. 418). This shows the importance of addressing the availability of the drugs in the community. However, reducing the availability of drugs was not considered as an important factor that influenced the trends for 80% of common illicit drugs as increased cost was actually thought to be responsible for decreased prevalence of substances such as marijuana and cigarettes (p. 425).

In a study done with National Survey on Drug Use and Health (NSDUH) 1999-2000 data, adolescent alcohol / drug use and dependence were found to be directly related to their perceptions of neighborhood disorganization and inversely related to their perceptions of social capital, even after adjusting for factors operating at individual and family levels. The authors

note that subjective perceptions of neighborhood are as important as objective measures and it is much easier to address these community level factors than those operating at the individual level. In this regard, the "downward drift" theory is not valid for adolescents, as they stay with their parents and do not choose their neighborhood (Winstanley et al., 2008).

Geographic differences in the prevalence of prescription drug abuse are well documented in the literature. From the beginning of 'Monitoring the Future study' until recently, students in the South reported lowest illicit drug use, even during periods of overall low prevalence. Whereas, highest rates of drug use were observed in the Northeast region (44% in 2010). Students in the South and the Midwest (36%) had the lowest annual prevalence in 2010, whereas 39% of those in the West reported use in the same year (Johnston et al., 2011). Although, more recent trends indicate that regional differences in the non-medical prescription drug use are not that prominent by 12th grade, there are certain differences observed for specific drug classes, especially in the lower grades. For example, lower grade students reported higher amphetamine use in the Midwest and the South, and those in the West and Midwest reported higher Vicodin use, whereas, steroid use increased many fold in all regions during 1998-99 as a consequence of imitation of risky behaviors of athletic role models (p. 181). Although illicit drug use in the past year is highest in the Northeast (44%) for 12th graders, Marijuana use was probably responsible for these regional differences. Northeast region actually has lower rates in the lower grades for illicit drug use other than marijuana (4.6%), when compared to the other three US Census Bureau regions- Midwest, South, and West. Not much regional variation was observed for 12th grade past year use of some illicit drug other than marijuana (17–18%). The 8th, 10th, and 12th grade tranquilizer use and 12th grade barbiturate use was higher in the south during 2010.

Monitoring the Future study also report drug use trends from the three Metropolitan Statistical Areas (MSAs) based on population sizes from Census data - large MSAs, other MSAs and non-MSAs (p. 182). In general, drug use appears to be pervasive and widely spread in all communities and therefore not much variation is observed in the usage patterns across these three levels of population density in 2010. Paradoxically, large MSAs which had highest prevalence for many commonly abused drugs in the past now appear to have the lowest prevalence for OxyContin, amphetamines, barbiturates, tranquilizers and steroids (p. 185).

Rural / urban differences have also been documented in some previous studies on substance abuse. In a study done by Booth, Leukefeld, Falck, Wang, & Carlson (2006) in rural Ohio, Arkansas, and Kentucky, a significantly higher use of non-prescribed opiates and tranquilizers, alcohol, marijuana and other drugs and was observed in users of both methamphetamine and cocaine.

In another study done on 2100 neighborhoods, the distribution of illicit drug use was found to be almost the same in different communities. Disadvantaged neighborhoods were found to have more than 6 times higher visible drug sales but only 1.3 times higher illicit drug use than the least disadvantaged neighborhoods (Saxe et al., 2001). In a study done with aggregated, self-reported survey data from forty Illinois counties, it was found that family supports (as measured by child care availability) and economic constraints (a composite variable) decreased and community disorganization (as measured by housing vacancies) increased the risk of 8th graders' substance abuse (alcohol, tobacco and drugs) (Hays, Hays, & Mulhall, 2003). Although prescription drug abuse is hidden from public view and does not make sensational news in the media as the abuse of illicit substances, it nevertheless is a public health problem of increasing magnitude.

Level four factors- Society (cultural and policy factors)

Even in this age of pop-a-pill culture, some individuals and communities have a stoic disregard to pain and rarely seek treatment. Such perceptions may be subjective, but in general there is a lowered threshold for pain or any discomfort recently and people are taking drugs for a variety of pharmaceutical indications. Adolescents also are influenced by this pill culture and an initial pharmacological encounter may lead to nonmedical and recreational use later. Although physicians should not withhold prescription drugs from real patients, efforts should be made to identify "doctor shopping" and stricter checks and regulations should be in place for commonly abused prescription drugs.

Policies

The National Drug Control Strategy aims for a 15 % reduction in the past year abuse of prescription psychotherapeutics in the individuals aged 12 years or more during the next five years ("Prescription Drug Abuse | The White House," 2011). To achieve this goal, the current prescription drug abuse prevention plan (2011) proposed by the Office of National Drug Control Policy focuses mainly on addressing the abuse of prescription opioids and identifies education, monitoring, proper disposal, and enforcement as the four major areas for intervention. Both supply control and demand reduction strategies have been a part of the national drug policy.

While interventions based on supply control aim to decrease access to the prescription drugs for non-medical reasons, those based on demand reduction try to bring changes in the individuals so that they do not seek the drugs (Pentz, 2006). Law enforcement to prevent diversion, interdiction policies and measures such as increasing tax are a part of the supply control strategy. School drug policies to educate adolescents are mostly based on the principle of

demand reduction (Pentz, 2006). Harrison act, the federal controlled substances act, the drug abuse prevention and control act, the Harold Rogers prescription drug monitoring program are some laws passed for supply reduction. Community mental health centers act for treatment of addictions is an example of a law for demand reduction (Califano Jr & Bollinger, 2005).

Adolescents themselves can obtain medicines from the drug cabinets or parents may inadvertently encourage them to take unused medicines as home remedies. Therefore, one of the main goals of the current prescription drug abuse prevention policy is to educate parents and public to make them realize that abuse of prescription drug is as dangerous as that of illicit drugs and that it is important to properly dispose unused medicines in the home drug cabinets. Prescription drug disposal programs and campaigns such as "national take back initiative" started in 2010 (Stoddard & Huggett, 2012) provide public with opportunities for proper disposal of unused medicines to prevent diversion.

Health care providers have an important role to play in addressing the adolescent prescription drug abuse. Therefore, training health care providers and reforms in medical and pharmacy education have been included in the current drug policy. Yoast, Wilford, & Hayashi (2008) studied physician screening of substance abuse disorders and mentioned that physician lack of skills and self-efficacy in patient counseling, inadequate training at all levels of medical education, and lack of reimbursement are some of the obstacles. This is not surprising as more than 44% of the US medical residency programs do not provide substance abuse related education (“Prescription Drug Abuse | The White House,” 2011). Yoast et al. (2008) suggest that there should be practice-based training with emphasis on screening and counseling skills. It is also important for the physicians to discuss the proper use of prescription medications with their patients and their families (Boyd, McCabe, Cranford, & Young, 2007). Physicians should also be

trained in writing prescriptions to avoid inappropriate prescribing practices and getting cheated by those who abuse drugs (Chappel, 1991). A national drug prescription training program is essential to train doctors with proper evidence based prescription guidelines (Devi, 2011). Due to the unconventional risk profile of the prescription drug abusers and the difficulties associated with identification, physicians should be trained to recognize these patients who may purchase drugs from illegal and the pharmacies (Jena, Goldman, Foster, & Califano Jr., 2011).

Brown, Swiggart, Dewey, & Ghulyan (2012) recommend appropriate substance abuse training of medical students and physicians by making screening, brief intervention and referral for treatment (SBIRT) a part of the medical education and continuing medical education programs. Primary care providers are especially encouraged to use such instruments as studies show benefits with even a little time spent in screening. Therefore measures are being taken to train healthcare providers to recognize and address the prescription drug abuse problem in patients ("Prescription Drug Abuse | The White House," 2011). There are also proposals to reward providers for using the PDMPs as proper reimbursement will help in addressing the problem of inadequate screening. However, with the current economic conditions, implementation of such monetary encouragement is doubtful.

Evidence in support or against supply control or demand reduction policies is scanty as measuring, modeling and evaluating policy induced changes is often a challenging and difficult task. Direct interdiction policies such as school drug testing have generated controversy and remain subject to debate (Pentz, 2006). For example, the American Academy of Pediatrics and majority of physicians opposed the recommendation by the Office of National Drug Control Policy (ONDCP) to make screening of adolescent's urine as an eligibility criterion for participation in the extracurricular activities. Using validated instruments to screen those at risk

and recommending treatment programs to the drug abusers were considered to be equally effective (Irwin Jr., 2006). Thus, there is some variation even in the medical community with regard to adherence to such policy recommendations. Pharmaceutical companies are also being encouraged to do research and develop abuse resistant drug formulations.

In addition, the current prescription drug abuse prevention policy places high importance on the communication of patient prescription records electronically between the providers, agencies and states. Specifically, legislations such as the National All Schedules Prescription Electronic Reporting (NASPER) Act have been introduced to encourage and funds the states to adopt and implement the prescription drug monitoring programs (PDMPs). The PDMPS can identify drug abuse epidemics, drug diversion and insurance fraud in the states where they are implemented ("Prescription Drug Abuse | The White House," 2011). Although PDMPs have become the mainstay for the prevention of diversion, they are being implemented in 35 states only.

In addition to the PDMPs various agencies such as NIDA Community Epidemiology Workgroup, Drug Abuse Warning Network (DAWN), and CDC's real-time BioSense surveillance system are also involved in the prescription drug abuse surveillance to monitor trends and identify areas with high incidence or prevalence ("Prescription Drug Abuse | The White House," 2011). As a part of the current policy, efforts are also being made to strengthen the reach of law enforcement agencies to take action on illegal prescribers, rogue pain clinics or "pill mills', doctor shoppers and those involved in diversion. Therefore, linkage of PDMPs and electronic health records systems and monitoring prescription claims in the state or work benefits programs have also been suggested (CDC, 2011).

In a study done with 'Monitoring the Future' study data from the years 1998-2001, Kumar, O'Malley, & Johnston (2005) found that neither "supportive" policies nor "punitive" policies such as monitoring, number of security measures, and severity of consequences for violation of school policies were significantly associated with substance use. The effect of school policies related to substance use seems to be dependent on the way they are stated. In a study done with 2004-2005 tobacco policy data from Canadian schools, it was found that an anti-smoking policy's effect on smoking prevalence was dependent on whether purpose and goals were clearly stated or not. Lower prevalence at both school and individual level levels was seen only if they were clearly stated, if not the policy's effect was limited to school level only (Lovato et al., 2010).

Drug abuse prevention policies can be considered as important measures that can prevent and change abuse behaviors at the community level. Such population based systems approach is necessary for a recurring problem such as adolescent drug abuse, as individual level approaches can bring immediate success but often fail to maintain the behavioral changes and only changes in the drug use related social norms will sustain in the long term (Pentz, 2006). Local ordinances or policies such as implementing mandated educational programs, drug free zones in the schools and community etc. thus play an important role in addressing the community level drug problems. The cost-benefit ratio of programs based on comprehensive local prevention policies that target the whole community is high (Pentz, 2006). The influence of decriminalization or legalization of the use of marijuana in many states on prescription drug abuse is not yet known. For example, strict regulations on illicit substances may fuel an increase in the abuse of prescription drugs.

Manchikanti (2007) discusses the need for effective and coordinated programs to address the prescription opioid epidemic and calls for measures such as prohibition of internet pharmacies, initiative to develop prescriptions that are resistant to abuse with better labeling and train physicians with evidence-based prescribing guidelines. The author also recommends strict monitoring of programs such as monitoring of methadone clinics with some specific measures such as making it mandatory to report addiction cases, restricting these clinics for the management of heroin addiction only, using low dose hydrocodone instead of high dose methadone and training the staff for buprenorphine administration.

Media

Diffusion of Innovations model can be particularly useful for examining the influence of media and internet, for example about how a new prescription drug or new social norms such as pharm parties (Haller & James, 2010) spread in the adolescent population. In this regard, socio ecological level four factors such as media can be considered a vectors or agents that spread stories that may increase, decrease or limit the diffusion of new drugs or social norms (Ferrence, 2002). Media and internet can be a double edged sword and the same internet and media venues that have been associated with drug abuse can be used to reach the adolescents and convey the anti-prescription drug abuse messages more effectively.

Cassels et al. (2003) found that US media descriptions of many commonly used drugs were biased in that potential positive effects were highlighted (Mintzes, Morgan, & Wright, 2009) and nearly five times more commonly mentioned than negative or harmful effects. Media descriptions did not mention adverse effects (53%) and quantification of benefits (40%) were not provided in this study. Media reports can provide valuable information about emerging drug

epidemics but news reports were also found to be significantly associated with deaths due to drugs such as opioids. Mass media should therefore report responsibly to avoid increasing the drug popularity and demand inadvertently. However, media guidelines for the proper and responsible presentation of prescription drug related information in the media are rarely provided (Dasgupta, Mandl, & Brownstein, 2009).

While the advertising against the illicit drugs has decreased, direct-to-consumer advertising (DTCA) has increased significantly. Pharmaceutical companies have a strong lobby in the US and can influence the policies related to DTCA. For this reason, although direct-to-consumer advertising is banned in Canada, there are no such restrictions in the US. The per capita spending on advertising is also 24 times higher in the US (Mintzes et al., 2009). The amount spent by pharmaceutical companies on advertising of prescription drugs has increased to $4 billion per year in the US ("Policy Statement Children, Adolescents, Substance Abuse, and the Media," 2010). Whereas, not even half this amount is spent on research, such as creating abuse resistant prescription drugs.

According to 'Monitoring the Future' study, there is a considerable decrease in the 12th graders' exposure to anti-drug ads in the media. This is a worrying fact as media coverage was thought to have played a very important role in the decrease of smoking rates, usage of substances such as ecstasy, club drugs such as Rohypnol or 'date rape" drug. Whereas direct-to-consumer advertising (DTCA) can be considered as a successful campaign for the pharmaceutical companies, as many patients ask their physicians for the advertised drugs and physicians usually comply. Adolescents also can get influenced by such advertising and consider that it is a norm to take a pill for every physical or mental health problem, due to an

overestimation or misinterpretation of the pharmaceutical effects of the prescription drugs. The negative effect of media on illicit substances and smoking has been known since a long time but the impact of direct-to-consumer advertising (DTCA) on the prescription drug abuse problem in the adolescents has not been studied in detail. Twombly & Holtz (2008) did a literature review on adolescents' knowledge and attitudes related to prescription drug use from a socio ecological point of view and concluded that direct to consumer advertising (DTCA) of prescription drugs in the media reinforces false notions among adolescents about prescription drugs. However, in a qualitative study done in a US city, Quintero & Bundy (2011) found young adults as skeptical and digitally literate individuals capable of evaluating the prescription drugs related information on the internet quite impressively.

The American Academy of Pediatrics (AAP) made many policy recommendations (2010) that target media related factors in the different socio ecological levels ("Policy Statement Children, Adolescents, Substance Abuse, and the Media," 2010). Specifically, the American Academy of Pediatrics recommended that parents should allow only supervised and controlled access to movies and television programs that have substance use related content and watch the media together whenever possible and discuss the content. The current national youth anti-drug media campaign has mixed results and therefore the American Academy of Pediatrics suggested that the schools should revamp the drug-prevention programs and include media education that encourages the adolescents to be skeptic and help in informed processing of the drug related messages. The policy statement also highlighted the importance of having open discussions with the pharmaceutical companies and other stakeholders about the negative consequences of media advertising and called for tougher laws on drug advertising to prevent adolescent prescription drug abuse.

Many internet pharmacies sell drugs without prescription. Although the Ryan Haight online pharmacy consumer protection act was passed in 2008 to address this issue, nearly 75% of the pharmacies operate from regions where such laws cannot be applied (Jena et al., 2011). A national registry of certified online pharmacies can help but due to loopholes in the law enforcement, search engines display advertisements and information about illegal internet pharmacies (Jena et al., 2011).

Sources for prescription drugs

The sources from which adolescents obtain prescription drugs vary. Monitoring the Future survey data (Johnston et al., 2011) for the years 2009 and 2010 were combined to find out the relative importance of common sources such as friends or relatives, own prescriptions, drug dealers or strangers, the internet or some other method for the three commonly abused psychotherapeutic drugs- amphetamines, tranquilizers and narcotics other than heroin. Results indicate that friends and relatives were the most common sources of these psychotherapeutic drugs for the 12th (p. 459).

Majority of these prescription drugs were either "given for free by friend or relative" (57–64%) or were "bought from friend or relative" (37.8-50.3%). Friends appear to be the single most important source as "given for free by a friend" (52.5-59.5%) and "bought from a friend" (37.2-49.6%) were found to be more common than "given free by a relative" (6.9-15.9%) or "bought from a relative" (1.6-3.8%) (p. 460). These results were different from a previous study which found that family members (34%) were more common sources of prescription pain

medication than friends (17%) and dealer or theft (14%) (Boyd et al., 2006). Thus, not only is there a change in the commonly abused drugs, but there is also a change in the sources with time.

"Bought from a drug dealer/stranger" was found to be the next most common source for tranquilizers (29.4%) and amphetamines (20.8%) but not for narcotics other than heroin (19.5%). For this last group of drugs, "from a prescription I had" (32.5%) was found to be more common than buying from dealers or strangers. Leftover prescriptions were an important source of this group of drugs. A significant number of the 12th graders mentioned "from a prescription I had" (19.2%) as a source for the abused amphetamines (Johnston et al., 2011).

Obtaining these drugs by any "other method" was also more common for amphetamines (16%) than with narcotics other than heroin (11%) and tranquilizers (9%), thus highlighting the relatively higher importance of diversion for stimulants (p. 460). Diversion of stimulants was found to be an significantly associated with abuse and related to the high number of students who were prescribed with these drugs in a previous study done by Poulin (2001) on a sample of 13,549 students from 7th, 9th, 10th and 12th grades students. With regard to diversion, there were some gender differences observed in a previous study done by Boyd et al. (2007) on 1086 students in grades 7-12 in a southeast Michigan school district. The authors found that girls (64.0%) were more likely than boys (21.2%) to divert their prescription medications, especially to friends of the same sex. The authors report that some students (10%) even diverted drugs to their parents. Monitoring the Future survey data (2009-2010) "taken from a friend or relative without asking" was more common for tranquilizers (18.6%) and narcotics other than heroin (18.8%) than for amphetamines (11%). Because of these reasons, campaigns such as "National

Take-Back Initiative" (Stoddard & Huggett, 2012) are very relevant to tackle prescription drug abuse problem in the adolescents.

Contrary to expectations, “bought on the Internet” was not a common source for obtaining tranquilizers (5.9%), amphetamines (3.9%) and narcotics other than heroin (1.1%), probably because of the problems associated with receiving the shipped orders while staying with their parents (Johnston et al., 2011). However, internet plays an important role in the spread of prescription drug abuse behavior among the adolescents. In addition to the easy of obtaining drugs from the internet pharmacies, exposure to drug related information on the internet is also a concern. Increased social networking brings new challenges as they facilitate the diffusion of new drugs in the adolescent community. As a consequence of these hyper connected online communities, knowledge about various new drugs and perceived availability of these drugs has increased among the internet/tech savvy younger generation and this contributes to the continuation of the drug abuse problem. Although internet pharmacies are not mentioned as a major source for the abused prescription drugs by the adolescents surveyed in ‘Monitoring the Future’ study, they still remain a threat as many of these pharmacies sell drugs without prescriptions (Twombly & Holtz, 2008).

Prescription Drug Abuse Prevention

There are so many substances that are abused that it is almost impossible to implement enforcement on all of them. This is especially difficult if the abused substances are not illegal like the prescription drugs. Also, adolescents continue to find ways to indulge in risky behaviors and even if there are tight regulations on any substance, some other substance or drug may replace it. Therefore, demand reduction appears to be a more promising approach than the supply

control. Strang et al. (2012) discuss drug policy with a four-tier pyramid, where interventions directed at the individual are represented in the top tier and those that target population in the bottom tier with interventions that target either or both falling in the second and third tiers. The authors note that there is no universally recommended strategy for drug abuse prevention programs because of the regional and chronological variation in the nature of the abuse. They examine evidence for various strategies and conclude that supply control or other legal measures can be effective to control drug use epidemics but changes cannot be sustained in the long term. Criminal sanctions on individuals for use or possession can be similarly effective. Prescription regimens and prescription monitoring systems can work but replacement with other similar drugs and stifling of supply to those with genuine need were mentioned as some major concerns. Even with the small effect sizes, screening and brief intervention programs were found to be cost effective. Supply reduction and legal measures are also difficult to implement because the most common sources of diversion are family and friends (Strang et al., 2012). Diversion of legitimate prescriptions and trafficking these drugs thus remain a big problem.

Individual and interpersonal health behavior theories are important in understanding the mechanisms of factors operating in the corresponding levels and are applied in many drug abuse prevention programs. Transtheoretical model (TTM) is probably useful to predict an adolescent's willingness to stop abusing prescription drugs by putting them into discrete behavioral stages such as pre-contemplation, contemplation, preparation, action, maintenance and termination. While this model has been successfully applied in many smoking cessation and de-addiction programs, it may not be of much use for the primary prevention of prescription drug abuse. For example, Sutton (2001) found inaccuracies with the construct measurement methods and staging

procedures and concludes that there is very little evidence in support of the utility of this theory in the field of substance abuse.

Johnson et al. (2007) suggests that a single targeted approach to preventing such a drug problem in a community is unlikely to be sufficient to reduce use and abuse at the youth population level. Ferrence (2002) studied the diffusion of Innovations model proposed by Everett Rogers and concluded that this model is especially useful for developing programs and policies for drug abuse prevention. Although targeting the level one and level two factors may be necessary for immediate results, a thorough understanding of the social determinants of prescription drug abuse is necessary to shift the focus of public health from individual to higher levels of etiological hierarchy. However, it is very difficult to convince the public as well as the agencies about the necessity to focus on the distal factors, as change in these factors is not easily measurable and it may take many years before positive results occur.

Prescription drug abuse is different from other substance abuse and there is a need for new strategies developed for addressing the prescription drug abuse problem in the current net savvy generation. For example a computer-delivered prevention program was found to be effective in changing substance use behavior of adolescent girls and mothers (Schinke, Fang, & Cole, 2009). Also Drug Abuse Resistance Education (D.A.R.E.) modules for upper elementary and middle schools may not have enough information about the risks of prescription drug abuse (Morris, Welch Cline, Weiler, & Broadway, 2006). In general, drug abuse prevention programs that taught refusal skills, social and personal competence skills, ways to resist pro-drug influences were successful previously (Botvin & Griffin, 2007). Strengthening of family bonds and improving peer-resistance skills will help in the success of drug abuse prevention programs (Sung et al., 2005). Dickinson et al. (2005) suggest that team-centered, peer-led interventions

with nationwide focused educational efforts, research, and strict legislations will help to control anabolic steroid abuse. Interventions targeted for the community may be the best methods to decrease abuse of stimulants in middle and 12th grade students (McCabe, Teter, & Boyd, 2004).

Summary

Large national surveys such as the Monitoring the Future study provide important information about adolescent drug abuse but they often fail to recognize regional drug abuse epidemics which usually occur more commonly in the younger populations. According to the Monitoring the Future study, one in every five 12th grade students (21.7%) used prescription drugs for non-medical reasons at least once in lifetime. The current relapse phase of the epidemic appears to be spreading from schools to colleges.

Narcotic drugs other than heroin such as Vicodin and Oxycontin appear to the most important group of drugs commonly abused followed by downers in the 12th graders. These drugs can be addictive and result in huge costs to the society in terms of emergency department (ED) visits and overdose related deaths. Although the prevalence of stimulants has decreased in general, newer stimulants appear to have replaced the older drugs in recent years. Abuse of anabolic androgenic steroids is not limited to athletes and their adverse effects are especially worrying. The prevalence of Ketamine, a party drug, is usually low in the 12th graders. In general, the use of prescription drugs is more common for pharmacological indications than for recreational purposes.

Level-one factors include intrinsic qualities in the adolescent responsible for the prescription drug abuse and individual level health behavior theories best explain their mechanism. Although this level is the usual target for prevention programs and can reap

immediate benefits, the results are short term and cannot be sustained. Adolescent beliefs, perceptions and preferences change frequently and influence the trends. Perceived harmfulness can lead to personal disapproval, which can further influence the norms in peer circles. In general, males and Whites have highest prevalence and African-American students have the lowest prevalence for most prescription drugs abused. No social stratum is immune to this drug abuse problem. Having clear academic plans seem to have a protective effect. Not surprisingly, friends appear to have a greater influence on drug use related attitudes than parents for the 12th graders.

Positive school climate and a positive sense of community, and participation in school/community-based organizations can protect against drug abuse. Increased prescriptions and availability, of the prescription drugs is one of the common reasons cited for increase in the abuse of prescription drugs. Drug abuse prevalence appears to be dependent on the community availability which mirrors perceived availability of the drugs. However, reducing the availability of drugs was not considered as an important factor that decreased the use of many commonly used drugs. South had lowest and northeast region had highest prevalence of illicit drug use previously but many regional differences have now disappeared. Prevalence in Large MSAs reversed and is now lower than the other MSAs.

The National Drug Control Strategy aims for a 15 % reduction in the past year abuse of prescription psychotherapeutics and both supply control and demand reduction strategies are used, although the latter is more commonly employed in the schools. Evidence in support or against either strategy is scanty. Prescription drug disposal programs, training health care providers, reforms in medical and pharmacy education , prescription drug monitoring programs

(PDMPs) to control illegal prescribers, doctor shoppers and those involved in diversion are all components of the current drug policy.

Direct-to-consumer advertising (DTCA) does not provide complete details always and appears to promote 'taking a pill for everything is ok' norm in the adolescents. Friends and family appear to be the most common sources and for this reason, supply reduction and law enforcement may not work as with the illicit drugs. Increasing number internet pharmacies, which are not an important source for adolescents, can still be a source of problems for drug control as they sell drugs without prescriptions.

CHAPTER 3
METHODS

Statement of the purpose

The purpose of this study was to examine epidemiological patterns of prescription drug abuse in Illinois 12th grade students.

Specific aims

The specific aims of the study were as following:

- to perform a cross-sectional study about prescription drug abuse in Illinois 12th grade students
- to identify high risk sub groups and examine the differences in prescription drug abuse patterns by demographic variables such as age, gender, race/ethnicity and geographic location
- to identify risk/protective factors for prescription drug abuse operating at individual, family, school and community levels
- to study the association between prescription drug abuse and other substance abuse disorders among Illinois 12th grade students

Factors responsible for the differences in the patterns of prescription drugs abuse were explored in this study.

Research questions

The following research questions were postulated to test the influence of variables from different socio ecological levels on 12th graders' prescription drug abuse.

Research Question 1: Are there any differences in prescription drug abuse patterns by demographic variables such as age, gender, race/ethnicity and socioeconomic status (SES)?

Research Question 2: Does having clear academic/future plans protect Illinois 12th graders against prescription drug abuse?

Research Question 3: Is there a significant relationship between 12th graders' prescription drug abuse and past year alcohol, tobacco and other illicit drug use (ATOD), OTC drug use, gambling and depression?

Research Question 4: Does perceived peer drug use of 12th graders explain prescription drug abuse?

Research Question 5: Do family rules influence prescription drug abuse of the Illinois 12th graders?

Research question 6: Do school level factors such as bullying, presence of a caring teacher /adult, being happy with school, rural/ non rural location, and proportions of low SES students and White students influence the prevalence of prescription drug abuse?

Research question 7: Do school district level variables such as perceived community norms, perceived availability of alcohol, tobacco and other drugs, rural/ non rural location, and proportions of low SES students and White students determine prescription drug abuse patterns?"

Research hypotheses

The following hypotheses were proposed based on the above research questions:

1. There are significant demographic differences in prescription drug abuse among Illinois 12th grade students.
2. Having clear academic/future plans protect Illinois 12th graders against prescription drug abuse.

3. Past year alcohol, tobacco and other illicit drug use (ATOD) use, OTC use, gambling and depression predict prescription drug abuse of Illinois 12th grade students.
4. Perceived peer drug use can explain prescription drug abuse of Illinois 12th grade students.
5. Family rules/expectations influence prescription drug abuse of the Illinois 12th grade students
6. The prescription drug abuse behavior of Illinois 12th grade students varies among the different schools.
7. School district level factors influence the prescription drug abuse behavior of Illinois 12th graders.

Data sources

The Illinois Youth Survey (IYS) is conducted every two years and the data are collected by the Lighthouse Institute for the Illinois State Board of Education (ISBE) and Illinois Department of Human Services (DHS) from participating private and public schools (Center for Prevention Research and Development, 2010). This survey collects important data about individual risk and protective factors for drug use, bullying, mental health, other health behaviors and school and community environment. Questions in the survey were broadly grouped into demographics, community, drug use, physical and other injury, individual/peer, nutrition/fitness, school, and family sections (Center for Prevention Research and Development, 2010).

The Illinois Youth Survey (IYS) data collected during 2010 has important information about risk and protective factors related to substance and prescription drug abuse from Illinois school students and are maintained by the Center for Prevention Research and Development (CPRD), which mainly focuses on research related to public policy and increasing the capacity of families, school and communities for prevention. This secondary data from the three different Illinois Youth Survey (IYS) forms completed by the 12th grade students were used in this study.

In addition to the data from CPRD, information from other online sources such as CPRD website, Illinois State Board of Education website and Census.gov was also used.

Study population

Illinois 12th grade students during the year 2010 were the study population in this study. Illinois Youth Survey is an anonymous survey with voluntary participation. In addition to seeking passive consent through a parent notification letter, consent was also sought by informing the parents through school websites/social network pages, email/listservs, newsletters or at PTA meetings (Center for Prevention Research and Development, 2010). 12th grade students who had passive parental consent and those who answered "I was very honest" on the final question "How honest were you in filling out this survey?" were included in the analysis. This study was approved by the Institutional Review Board at the University of Illinois at Urbana-Champaign.

Although Illinois Youth Survey is free, not all schools participate in it. Among the schools that are eligible, 1104 schools participated in the 2010 Illinois Youth Survey (Center for Prevention Research and Development, 2011a). The overall school participation rate was 82.7% in the 2010 Illinois Youth Survey, and represents an increase of 18.1% compared to the 2008 Illinois Youth Survey. While public school participation increased from 741 (64.5%) in 2008 to 966 (84.1%) in 2010, private school participation increased only from 86 (65.2%) in 2008 to 93 (70.5%) in 2010. Support to tackle problems identified through Illinois Youth Survey, in the form of funding, training or material supply, may encourage reluctant schools to participate.

Research design

Cross-sectional study design was used for this study. Students in a school share similar environmental influences and are grouped into natural clusters (Johnston et al., 2011). Therefore,

multilevel logistic regression was used to examine the effects of individual and school level variables on the abuse of prescription drugs. Stratification of the data was done by demographic characteristics such as gender, race, and family income (eligibility to receive free/reduced price lunch). Cross-level interactions between the individual, school and community level covariates were also studied.

Measures/variables that were used in the data analysis

Dependent variable

The dependent variable for this study was based on the following question in the Illinois Youth Survey- "During the past 12 months, which of these drugs have you used without a doctor's prescription? a. Steroids, b. Uppers (Ritalin, etc.), c. Downers (Valium, Ambien, etc.), d. Other prescription drugs (OxyContin, Ketamine, etc.)". The data collected for this question was recoded into four binary dependent variables "Steroid abuse," "Uppers abuse," "Downers abuse, "and "Other prescription drugs abuse". Although opioid analgesics are the most commonly abused prescription drugs, analysis will not be performed for this group of drugs, as there was no separate item on the 2010 Illinois Youth Survey questionnaire for opioid drugs.

Independent variables

Level one

Demographic:

Socio ecological level one includes demographic variables such as age, gender, race/ethnicity, socioeconomic status (SES). School lunch eligibility was used to determine the socioeconomic status. Socioeconomic status (SES) of the students was considered as 1) low if the student is eligible to receive free lunch, 2) middle if eligible to receive reduced price lunch

and 3) high if eligible for neither. Gender, race/ethnicity, and SES variables were recoded as dichotomous variables.

Academic:

Having clear college/future plans about a post high school program such as vocational training program, military service, community college, or 4-year college was recoded as a dichotomous variable and entered into the multilevel regression model.

Substance Abuse:

Students' responses to the question "How old were you when you began drinking alcoholic beverages regularly, that is, at least once or twice a month?" and usage frequency of cigarettes and other tobacco products during the past year was recoded. Similarly, usage of other drugs such as marijuana, MDMA ("ecstasy"), LSD or other psychedelics, cocaine or crack, meth (methamphetamine) and heroin during the past year were also be recoded. A summary variable for the alcohol, tobacco, and other drug use (ATOD) was created from the variables related to the above questions.

Other student variables

Two individual level variables depression and gambling were added to the final multilevel model as they were found to be significant in the initial exploratory analyses.

Peer:

One peer related variable was included as level one variable. A summary variable 'perceived peer drug use' was created for the questions on alcohol, tobacco and other drug use "What percent of students at your school do you think have used ATOD in the past 30 days?".

Family:

The responses to the question "My family has clear rules about alcohol and drug use" was recoded and included as level one variable.

Level two

Responses of students for independent variables of interest were aggregated by school and were used in the analysis. School-level variables include the percent of minority students, percent of students in the low SES (free lunch) category, percent of students reporting bullying, percent of students reporting unsafe at school, percent of students who reported being a member of a street gang in the previous year, and the school locality based on the school zip code.

Aggregated variables such as perceived community norms, perceived availability of alcohol, tobacco and other drugs, student participation in community activities, rural / non-rural (school / school districts), neighborhood safety, proportion reporting bullying, presence of caring teacher/adult at school, being happy with school, and proportion of low SES and white students were used as level two explanatory variables in the different multilevel models.

School drug policies may not vary across all high schools in Illinois but local government ordinances may influence the drug atmosphere and can probably account for the unexplained variation. Certain conditions within the communities may influence prescription drug abuse patterns. The Center for Prevention Research and Development (2010) defined four area types for the public schools in the Composite Prevention Profiles – 1) Chicago, 2) Suburban Chicago, 3) Other Urban/Suburban, and 4) Rural counties. These community types were dichotomized as rural and non-rural and used as a level two variable for both schools and school districts. This was done to meet the minimum requirement of the number of groups in the higher levels. School district is the natural upper level in the data hierarchy and there is no geographical administrative overlap for location of schools, as in the case of counties. Also, school/school district may reflect

the actual living environment of the 12th graders in a better way than the four larger geographical areas.

Multilevel studies typically need more data at higher levels and therefore due to the lack of adequate number of level two units (schools), school districts were not included as level three in this study. Instead two separate two level logistic regression analyses were conducted by choosing either schools or school districts as level two units in different models to study the influence of contextual predictors on 12th graders' prescription drug abuse.

Preparing the data for analysis:

Silman & Macfarlane (2002) listed various steps in preparing epidemiological data for statistical analysis such as checking data completeness and accuracy, linking multiple data sources, coding data, developing a database, entering data, checking for errors and inaccuracies on the entered data, dealing with missing data, re-coding data variables and storing of the dataset and database.

Survey Research Laboratory at the University of Illinois prepared the weighted dataset obtained from the CPRD. This data was reviewed at the beginning of this study for completeness and accuracy specifically to find missing values, inappropriate multiple responses, and inconsistencies. Protocol to deal with such errors was formulated at the beginning of the data analysis. Students who did not respond that they were completely honest and those with extreme values for study variables such as age were excluded from the analysis.

Data coding was done for multiple categories in categorical variables and recoding was done for categorical and continuous variables wherever necessary. Missing values were coded differently from responses such as "don't know". Cases with missing values were excluded from the analysis.

Data preparation with statistical software

Computer data base was built to enable performing the analysis in statistical software packages such as SPSS, STATA, ArcGIS and Hierarchical Linear Modeling (Raudenbush, Bryk, & Congdon, 2004). Data preparation was first done in SPSS. Consistency of the responses for the categorical variables and range for continuous variables were examined to find out outliers and other inconsistent data.

Data analysis

In this study, univariate and bivariate analyses were first performed to summarize and describe the cross-sectional data. Descriptive analysis of demographic and other important variables were done by creating histograms, bar charts, and 'stem and leaf' display of the distributions. Distribution and frequencies of important variables were examined. Frequency tables were then generated for categorical variables such as age, race, and geographical location. Prevalence of abuse of the four main types of prescription drugs in the past year is reported. Descriptive statistics and graphs such as boxplots and scatterplots were made for continuous variables. Boxplots and scatter plots were used to identify outliers in the different variables.

In this study, analysis was initially done to examine the relationship between predictor variables like individual, family, school and community factors and the dichotomized dependent variable- prescription drug abuse status. Cross tabulations were performed between categorical dependent variables and independent variables. Correlational analysis was performed to explore the relationship among continuous variables. Chi-square, t-tests and analysis of variance of the different groups was performed to identify statistically significant group differences.

All attempts were made to avoid collapsed data and loss of data due to missing values. Multilevel logistic regression was then used to obtain the model that would be the best predictor of the outcome variable - prescription drug abuse.

Multilevel logistic regression

The non-independence of observations is due to the multistage sampling and hierarchical structure of the Illinois Youth Survey data. It is important to take these sources of clustering into account when statistically analyzing the data. Treating observations as independent when they are not can lead to underestimation of standard errors, which in turn can inflate the type I error rate (Zhu, 1997). Therefore, multilevel logistic regression analyses were performed to test the hypotheses that independent variables in the three socio ecological levels are associated with the dependent variables, prescription drug abuse and each of the four subclasses of prescription drugs -"Steroid abuse", "Uppers abuse" "Downers abuse", and "Other prescription drugs abuse".

Hierarchical General Linear Model (HGLM) modeling was used to account for the multilevel structure of the data. HLM 6 (Raudenbush et al., 2004) software package was used for most part of the analysis. However, because of certain limitations in HLM software, the data files for different levels were first created using SPSS software (IBM Corp, 2011). HLM software was used for most of the data analyses. MDM file was created for the HGLM model using level one and level two SPSS files using appropriate identification variables for level one and level two. Descriptive statistics were then performed and the numbers of level one and two units were checked to ensure that the data from SPSS data files are properly read into the MDM file. Since the dependent variables are binary, the model was specified as Bernoulli in the generalized linear models (HGLM). A command file was then created using the MDM file and two level logistic regression analyses were performed.

An intercept-only null or empty model was fitted in the beginning. Student level predictor variables were then added to the model. Level two predictor variables were added to the model to study the effect of these variables on school level variation. Estimates from the single and two level models were compared. Influence of the predictors on 12th graders' prescription drug abuse was estimated with the fixed part of the model. Both level two group specific and overall Illinois state estimates of 12th graders' prescription drug abuse are reported. Cross level interactions of predictors of different socio ecological levels are also studied. The odds ratios and the amount of variance explained by both school and school district level predictors are reported.

CHAPTER 4
RESULTS

In this chapter, the results of the univariate, bivariate and multilevel logistic regression analyses will be described. Characteristics of the sample are described at the beginning. This is followed by a report of the 2010 prevalence of the dependent variables (all prescription drugs and the four subclasses-uppers, downers, others and steroids) among Illinois 12th graders. Bivariate analyses of the prescription drug abuse and predictors from student and school/school district are then provided. Results of the multilevel logistic regression analyses that tested the data for the seven research questions are then described. Tables and Figures from the data analyses are included as separate chapters after chapter 5.

Univariate Analysis

Sample description

The data from the 2010 Illinois Youth Survey was weighted by the Survey Research Laboratory at the University of Illinois. The dataset was adjusted for gender, race, low income, and absenteeism. The weighted sample obtained from the Center for Prevention Research and Development has 2,030 students in the 12th grade nested within 42 schools from 34 school districts in Illinois. Descriptive statistics of predictors at level one (students) and level two (schools and school districts) are summarized in tables 4, 5 and 6 respectively.

After selecting only those students who answered "I was very honest in filling out this survey" on the final question, 1552 students remained in the final study sample. After examining the age distribution of the sample, two outliers, both 10 years of age, were removed. The final study sample consisted of 1550 students in 12th grade from 42 schools in 34 school districts in Illinois.

The mean age of the 12th graders in the sample was 17.64 years with a standard deviation of 0.63. Figures 9 and 10 display the age distribution of the sample. The sample consisted of a higher number of male students (n=818, 53.01%) than female students (n=725, 46.99%). The study sample consisted of 948 White students (61.40%), 232 African American students (15.03%), 216 Hispanic students (13.99%) and 148 students belonging to other racial groups (9.59%) in 12th grade during 2009. Based on the eligibility for free lunch in the school, 532 students (34.46 %) can be classified as belonging to low SES. While the majority of the 12th graders mentioned that they will definitely (n=1128, 76.42 %) or probably (n=150, 10.16 %) attend college, a considerable number were not sure (n=91, 6.17 %) or mentioned that they will not attend college definitely (n=80, 5.42 %) or probably (n=27, 1.83 %).

Most of the 12th graders used ATOD (n=1040, 67.80 %) and a considerable number abused OTC drugs (n=284, 18.30 %) in the past year. An overwhelming majority of 12th graders (n=1529, 98.52 %), mentioned peer drug use in the past month. Most of the students mentioned that they have rules in the family about alcohol and drug use (n=1113, 75.36 %). Approximately, 31.51 % of the 12th graders reported gambling in the past year. While 21.96 % of the 12th graders reported feeling depressed for at least 2 weeks or more in the past year, 13.03 % also mentioned having suicidal thoughts in addition.

Bullying was reported by approximately 18.92% of the respondents. Schools varied with respect to the percent of students reporting bullying, with school level prevalence varying from a low of 4% to a high of 40%. Approximately, 89.55% of Illinois 12th graders acknowledged the presence of a caring teacher or an adult at school. However, at a school level this varied from a low of 67% to a high of 98%. Schools also varied from a low of 19% to a high of 81%, with

respect to 12th graders being happy to attend that school. Overall, 52.69% of Illinois 12th graders were happy with the school they attend.

The distribution of school districts by the type of community is reported in table 7. The study sample consisted of one Chicago, eighteen suburban Chicago, ten urban/suburban and five rural school districts. During 2010-2011, there were 4361 schools nested in 872 school districts in Illinois. The single school district "City of Chicago SD 299" has more than 600 schools. As the data was weighted by the Survey Research laboratory at University of Illinois to make the sample representative of Illinois, only 8 schools from the school district in Chicago were included in the weighted sample. Although only one school district from Chicago was included in the analyses, this represents 15% (n = 232) of the students in the study sample.

School districts ranged from 77% to almost 100% in terms of easy availability of ATOD (as reported by the 12th graders). Some school districts had nearly 12% of 12th grade students reporting that adults in their community do not consider their ATOD use as wrong. As many as 33% of 12th graders were from school districts that they reported as unsafe. During 2009, Illinois 12th graders reported participating in 4-H club (n=29, 1.9%), boys and girls club (n=65, 4.2%), faith-based youth group (n=407, 26.3%), scouting (n=42, 2.7%), service / voluntary projects (n=663, 42.8%), and other activities (n=938, 60.5%).Among the study sample, 632 (40.8%) Illinois 12th graders were members of school sports team and 507 (32.7%) Illinois 12th graders reported participation in other sports. In some school districts there were nearly 44% of 12th grade students that did not participate in any of the community activities.

Prevalence

Prevalence and trends of the abuse of all prescription drugs and the four subclasses-uppers, downers, others and steroids among Illinois 12th graders are reported in tables and figures 1-3. Illinois 12th graders (11.4%) had a lower prevalence than the US prevalence (15.4%)

in the year 2009. The prevalence of the four subclasses of prescription drugs- uppers (6.1%), downers (6%), other prescription drugs (8.2%) and steroids (1.2%) is similar to national findings.

Both female (8.9% vs.13.7%) and male (14.2% vs. 16.1%) Illinois 12th graders have lower prevalence than US estimates. The prevalence among Illinois White 12th graders (11.5% vs. 17.8%) and Hispanics (9.7% vs.9.9%) is lower than US estimates, whereas Illinois African Americans have the same prevalence (7.3%) during 2009.While the questions about college plans were framed differently in the Monitoring the Future study and Illinois Youth Survey, prescription drug abuse prevalence was higher in Illinois 12th graders who have college plans (11.1%) when compared to those who do not have college plans(8.4%), whereas the US prevalence is lower among 12th graders with college plans(13.8%) when compared to those without college plans (20%).

Poly drug abuse is evident in the sample, as among Illinois 12th graders who abused prescription drugs, 5.7% abused prescription drugs from one of the four sub-classes, 2.6% abused prescriptions drugs from two of the four sub-classes, 2.5% abused prescriptions drugs from three of the four subclasses, and 0.8% abused prescription drugs from all the four subclasses.

Bivariate Analysis

Crosstabs

Cross tabulations of student level categorical independent variables and prescription drug abuse are reported in table 8.

Among Illinois 12th graders, 8.9% of females and 14.2% of males abused prescription drug during the year 2009 (Figure 11). The sample consists of predominantly White 12th graders

(66.07%) and the prescription drug abuse prevalence was almost the same for both White (11.4%) and non-White (11.1%) students (Figure 12). However, a further breakdown of the non-White racial group reveals that the prevalence among 12th graders belonging to "other" racial group (18.9%) was higher than for White (11.5%), Hispanic (9.7%) and African American (7.3%) students. Prescription drug abuse prevalence was higher among low SES students (12.1%) than among high SES students (9.8%) (Figure 13).

Illinois 12th graders with clear college plans (11.1%) had higher prevalence when compared to those without college plans (8.4%) (Figure 14). Depressed 12th graders (18.1%) reported higher prescription drug abuse than those who were not depressed (9%) (Figure 17).

When compared to non-users, prescription drug abuse was higher in Illinois 12th graders who reported past year ATOD use (15.3% vs. 2%) (Figure 15) and OTC drug use (34.9% vs. 6.2%) (Figure 16). Illinois 12th graders who gambled (16.8%) had a higher prevalence of prescription drug abuse than those who did not gamble (8.4%) during 2009 (Figure 18).

Not surprisingly, prescription drug abuse was lower in Illinois 12th graders with clear ATOD related family rules (9.6%) when compared to those without such rules (17 %) (Figure 19). Prescription drug abuse prevalence was also higher among Illinois 12th graders who perceived peer drug use in past month (11.5%) than among those who did not (4.3%) (Figure 20).

Of all the individual level predictors, gender (χ^2 =10.126, df =1, p=0.001), past year ATOD use (χ^2 =59.707, df =1, p<0.001), past year OTC drug use (χ^2 =186.317, df =1, p<0.001), past year depression (χ^2 =21.886, df =1, p<0.001), past year gambling (χ^2 =23.39, df =1, p<0.001), having clear academic/college plans (χ^2 =20.53, df = 4, p<0.001) and having clear

ATOD use related family rules (χ^2 =13.987, df =1, p<0.001) seem to be significantly associated with prescription drug abuse in 12th graders. Whereas race, low SES, and perceived peer drug use in the past month do not appear to have a significant relationship with 12th graders' prescription drug abuse.

Cross tabulations of school level predictors are reported in table 9. School variables such as belief in the fairness of teachers (χ^2 =25.418, df =1, p<0.001), feeling close to people at school (χ^2 =7.749, df =1, p = 0.005), being happy with school (χ^2 =18.041, df =1, p<0.001) appear to have a significant relationship with 12th graders' prescription drug abuse.

Cross tabulations of school district level predictors are reported in table 10. 12th graders' perceived community norms towards ATOD (χ^2 =18.041, df =1, p<0.001), participation in community activities (χ^2 =18.041, df =1, p = 0.032), perception of easy availability of ATOD (χ^2 =18.041, df =1, p<0.001) and type of community (χ^2 =18.041, df =3, p = 0.011) also appear to be significantly associated with prescription drug abuse.

Crude Odds Ratios

Crude odds ratios for student level (table 11), school level (table 13), and school district level predictors (table 14) are also reported. Bivariate analyses indicate that males (OR: 1.69, 95% CI: 1.229, 2.323, and those with past year ATOD use (OR: 8.735; 95% CI: (4.567, 16.708), past year OTC drug use (OR: 8.164; 95% CI: 5.842, 11.41), past year depression (OR: 2.235; 95% CI: 1.585, 3.151), past year gambling (OR: 2.2; 95% CI: 1.589, 3.047), and having clear drug related family rules (OR: 1.93; 95% CI: 1.376, 2.707) have significantly higher odds of prescription drug abuse in 12th graders.

Crude odds ratios for race with four categories are reported in table 12. When compared to Whites, African Americans appear (OR: 0.61, 95% CI: 0.36, 1.04) to have fewer and other racial group (OR: 1.8, 95% CI: 1.14, 2.84) appears to have higher odds of prescription drug abuse. Hispanics (OR: 0.83, 95% CI: 0.51, 1.36) also appear to have lower odds but the relationship was not significant.

Believing in the fairness of teachers (OR: 0.42, 95% CI: 0.29, 0.59), feeling close to people at school (OR: 0.63, 95% CI: 0.46, 0.88), and being happy with school (OR: 0.49, 95% CI: 0.35, 0.68) appear to have a protective influence against prescription drug abuse.

Similarly, 12th graders who perceive restrictive community norms towards ATOD (OR: 0.249, 95% CI: 0.134, 0.462) and participate in community activities (OR: 0.63, 95% CI: 0.412, 0.963) appear to be have significantly lower odds of prescription drug abuse. Illinois 12th graders who were members of school sports team or participated in other sports (n = 710, 53.3%) seem to have lower odds of prescription drug abuse (OR: 0.645, 95% CI: 0.453, 0.918) than those who did not participate in sports (n = 621, 46.7%).

Illinois 12th graders who perceive easy availability of ATOD (OR: 5.748, 95% CI: 2.104, 15.703) appear to have significantly higher odds of prescription drug abuse. Rural 12th graders do not appear to have significantly different odds than those from Chicago. Whereas, 12th graders from Suburban Chicago (OR: 1.856, 95% CI: 1.066, 3.229) and Urban/Suburban (OR: 2.431, 95% CI: 1.36, 4.348) seem to have higher odds of prescription drug abuse than those from Chicago.

Regional differences in prevalence

The prevalence of prescription drug abuse among Illinois 12th graders was 11.4% (10.2%, 13.1%) in 2009. This was found to be significantly different from the US prevalence of 15.4% (Ho: $p = 0.154$, Ha: $p \neq 0.154$, P-value <0.001)

There are significant between school differences in the abuse prevalence of all prescription drugs (χ^2 =1.514, p-value=0.02), steroids (χ^2 =1.298, p-value=0.045) and other drugs (χ^2 =1.532, p-value=0.017). The results for school districts are similar with significant between group differences in the abuse prevalence of all prescription drugs (χ^2 =1.782, p-value=0.004), uppers (χ^2 =1.522, p-value=0.03), other drugs (χ^2 =1.514, p-value=0.007) and steroids (χ^2 =1.57, p-value=0.02).

Multilevel Logistic Regression Analysis

Hierarchical Generalized Linear Model (HGLM) was used to create two MDM files with 2 levels to run multilevel logistic regression models with HLM version 6.06. Bernoulli model was used as the dependent variable is dichotomous. Restricted penalized quasi-likelihood (RPQL) was used to estimate both the variance-covariance components and the fixed effects in the model by maximum likelihood (Raudenbush, 2004).To account for the possibility of a larger level one variance, undetected clustering and the resulting under specification of the model, the option of overdispersion was chosen during the analysis (Raudenbush, 2004).

Continuous predictors were added grand centered in the model i.e. these variables were centered on the overall state means for Illinois 12th graders. Categorical predictors were added uncentered, and none of the independent variables were centered on the group (level two units-school/school districts) means.

Both fixed and random effects of the predictors in the model were estimated. Since missing data at any level can potentially bias the results in a multilevel study, run-time deletion was chosen as the method to deal with the missing data. This procedure excluded 239 level one units and 1 level two unit due to insufficient data during the analysis of model with students nested in school/school districts.

Model Summary

The overall model with both fixed and random effects is summarized as following:

Level 1 and 2 Models

Level-1 Model

$$Prob(Y=1|\beta) = P$$

$$\log[P/(1-P)] = \beta_0 + \beta_1*(\text{Age}) + \beta_2*(\text{Gender}) + \beta_3*(\text{Race}) + \beta_4*(\text{Low SES}) + \beta_5*(\text{College Plans}) + \beta_6*(\text{ATOD use}) + \beta_7*(\text{Gambling}) + \beta_8*(\text{OTC use}) + \beta_9*(\text{Depression}) + \beta_{10}*(\text{Family Rules}) + \beta_{11}*(\text{Perceived Peer ATOD use})$$

Level-2 Model (schools)

$$\beta_0 = \gamma_{01}*(\text{Bullying}) + \gamma_{02}*(\text{Caring teacher/adult at school}) + \gamma_{03}*(\text{Happy with school}) + \gamma_{04}*(\text{Rural schools}) + \gamma_{05}*(\%\text{White students}) + \gamma_{06}*(\%\text{ low SES students}) + u_0$$

Level-2 Model (school districts)

$$\beta_0 = \gamma_{01}*(\text{Community ATOD norms}) + \gamma_{02}*(\text{Community activities}) + \gamma_{03}*(\text{Perceived ATOD Availability}) + \gamma_{04}*(\text{Neighborhood safety}) + \gamma_{05}*(\text{Rural school districts}) + \gamma_{06}*(\%\text{White students}) + \gamma_{07}*(\%\text{ low SES students}) + u_0$$

Steps

An unconditional/null model was run initially to test for the presence of between group variance. Predictors from different levels were then added in a stepwise manner in the

subsequent models to test their influence on intercepts and slopes. The rationale for running the various models was to test for the presence of significant within and between school/school districts variance in prescription drug abuse and identify the important predictors in different levels that can explain individual or group differences.

Power and Sample size

Although this study used secondary data collected in 2010, a one-sample proportion test was done to estimate sample size and power to detect the difference between Illinois and US prevalence (Ho: p = 0.154) in the prescription drug abuse of 12^{th} graders. Results indicate that a power of 0.90 will be obtained with a required sample size of 758. However, in case of multilevel analysis, the number of groups in the higher levels is more important than level one sample size. In order to perform a three level logistic regression, a minimum of 30 units are required in the level two for each level three unit. The dataset has only 42 schools nested in 34 school districts. Therefore, only two level analyses were performed.

Multilevel logistic regression results

Descriptive statistics for prescription drug subclasses (table 15); student level predictors (table 16), school level predictors (table 17) and school district level predictors (table 22) obtained from the HGLM models confirm the accuracy of the MDM file created. Based on the choice of level-2 identifier, odds ratios and 95% confidence intervals for the models with schools (table 21) or school districts (table 26) are reported. Similarly, beta coefficients and standard errors (SE) for the models with schools (table 20) or school districts (table 25) are also reported.

Cross level interactions (Table 27), random effect estimates (Table 28); and model fit statistics (Tables 29 and 30) are also reported. HGLM model graphs that display the relationship between prescription drug abuse and predictors are included (Figures 21-30). Graphical representation for adjusted odds ratios of student level predictors and the abuse of all drugs (Figure 31), downers (Figure 32), uppers (Figure 33), other drugs (Figure 34) and steroids (Figure 35) is also provided for easier interpretation.

Level 1 (student)

Adjusting for all the other variables in the multilevel logistic regression model, Illinois 12th graders with past year ATOD use (OR: 6.095, 95% CI: 2.708,13.717), past year OTC drug use (OR: 6.081, 95% CI: 3.952,9.358), past year depression (OR: 2.381, 95% CI: 1.475, 3.844), and past year gambling (OR: 1.684, 95% CI: 1.069, 2.655) were found to have significantly higher odds of prescription drug abuse in 12th graders. Illinois 12th grade females (OR: 0.621, 95% CI: 0.386, 0.998) have significantly lower odds of prescription drug abuse in 12th graders.

In this model with race included as a dichotomous variable, the odds of prescription drug abuse in white 12th grade students were not significantly different from non-white 12th grade students (OR: 1.101, 95% CI: 0.679, 1.787). Other individual level variables such as age (OR: 1.120, 95% CI: 0.755, 1.661), low SES (OR: 1.199, 95% CI: 0.668, 2.153), having college plans (OR: 1.488, 95% CI: 0.595, 3.721), having clear ATOD related family rules (OR: 0.730, 95% CI: 0.463, 1.151), and perceived peer drug use (OR: 0.192, 95% CI: 0.018, 2.075) were also not significantly related to prescription drug abuse in 12th graders.

The findings for the four subclasses of drugs were similar to the overall results. ATOD use, OTC use, gambling and depression were significant for downers, uppers and other drugs

except steroids. OTC use was the only significant variable associated with steroid use. Downers and Uppers abuse did not show significant gender differences.

Level 2- Measures of Heterogeneity

Measures of heterogeneity such as intra class correlation (ICC) and median odds ratios (MOR) for the models with schools (table 19) and school districts (table 24) as level two are reported in this section.

ICC

Intra-Class Correlation (ICC) was calculated with sigma squared (σ^2) and Tau (τ) obtained from the null models (Raudenbush, 2004) to estimate the variance in the prescription drug abuse between schools and school districts using the following equation:

$$ICC = \tau / (\tau + \sigma^2)$$

The results indicate that except for the abuse of downers (1.14%), significant variance lies between schools for the abuse of all drugs (4.3%), uppers (5.57%), other drugs (6.48%) and steroids (34.19%). The results are similar for school districts and with the exception of the abuse of downers (3.04%), there was significant variance for the abuse of all drugs (4.58%), uppers (6.29%), other drugs (5.89%) and steroids (29.38%).

Median Odds Ratios

Median odds ratios (Larsen & Merlo, 2005) were calculated because ICC may not be as useful as in the case of linear models (Raudenbush, 2004). The median odds ratios (MOR) can quantify the unexplained between group variance and are easier to interpret than ICC (Sanagou, Wolfe, Forbes, & Reid, 2012).

The median odds ratios (MOR) between a 12^{th} grader from a school with higher prevalence and another 12^{th} grader from a school with lower prevalence (with the level one

covariates held constant) were 1.441, 1.205, 1.520, 1.574, and 3.462 for all drugs, downers, uppers, other drugs and steroids respectively.

Similarly, the median odds ratios (MOR) between a 12^{th} grader from a school district with higher prevalence and another 12^{th} grader from a school district with lower prevalence (with the level one covariates held constant) were 1.459, 1.356, 1.563, 1.540, and 3.039 for all drugs, downers, uppers, other drugs and steroids respectively.

Between groups (school and school districts) variances

The data provide evidence that the between school/school district variance in prescription drug abuse is significantly different from zero and the null hypothesis that the between school variance is not significantly different from zero can be rejected.

However, in the process of making the sample representative of Illinois, weighting of the sample probably made the schools more homogenous. As the proportion of school variance with respect to the total variation is low, the reliability is also low and can affect power of the study. The calculated median odds ratios for school and school districts were 1.441 and 1.43 respectively.

Between school variance was significant for uppers (likelihood ratio-χ^2=58.033, p = 0.041), others (likelihood ratio-χ^2=70.961, p = 0.003) and steroids abuse (likelihood ratio-χ^2 =132.171, p < 0.001) but was not significant for downers abuse (likelihood ratio-χ^2=43.518, p = 0.364). The results are similar for between school district variance for uppers (likelihood ratio-χ^2=52.744, p = 0.016), others (likelihood ratio-χ^2=58.953, p = 0.004) and steroids abuse (likelihood ratio-χ^2=81.611, p < 0.001) being significant but was not significant for downers abuse (likelihood ratio-χ^2=40.536, p = 0.172).

Multilevel model is required for this dataset because the residual between group variance is not equal to zero in the school null model (likelihood ratio-χ^2 =64.550, p = 0.011) or the school district null model (likelihood ratio-χ^2 =58.558, p = 0.004).

School level predictors

In the intercepts as outcomes model, schools with a higher proportion of white students (OR: 2.921, 95% CI: 0.667, 12.795) , low SES students at school (OR: 0.918, 95% CI: 0.169, 4.975) and those with a higher proportion of students reporting presence of a caring teacher/adult (OR: 6.629, 95% CI: 0.043, 1014.978), bullying (OR: 4.723, 95% CI: 0.165, 135.053), and being happy with school (OR: 0.222, 95% CI: 0.015, 3.360) seem to have higher odds of prescription drug abuse. However, none of the school level variables were found to be significant in the multilevel logistic regression analyses.

It is important to note that two school level aggregate variables, proportion of White students (p-value: 0.06) and proportion acknowledging the presence of caring teacher/adult at school (p-value: 0.052) appear to be close to statistical significance. While it is not statistically significant, school level bullying also appears to contribute considerably to the between school variation in the prescription drug abuse prevalence and the odds of prescription drug abuse were higher in schools with a higher proportion of 12th graders who reported bullying in the past year.

School district level predictors

In the intercepts as outcomes model, none of the school district level variables were significant in the multilevel logistic regression analyses. Contrary to expectations, school districts with a higher proportion of 12th graders reporting easy ATOD availability (OR: 0.178, 95% CI: 0.012, 2.615) and safety issues (OR: 0.494, 95% CI: 0.008, 31.707) do not have significantly higher odds of prescription drug abuse. Proportion of white students at White/Non-

White (OR: 3.874, 95% CI: 1.164, 12.899) and low SES students (OR: 1.032, 95% CI: 0.091, 11.775) at the school district level do not appear to be associated with prescription drug abuse. The results indicate that Illinois 12th graders from rural school districts do not appear to have significantly higher odds (OR: 0.865, 95% CI: 0.426, 1.754) of prescription drug abuse than those from non-rural school districts.

Although statistically significant results were not obtained, school districts with a higher proportion of students reporting adult disapproval of ATOD drug use (perceived ATOD community norms) (OR: 0.067, 95% CI: 0.001,7.846) and having opportunities for participation in community activities (OR: 0.178, 95% CI: 0.012, 2.615) seem to have lower odds of prescription drug abuse.

Cross Level Interactions

Four cross level interactions were tested in the multilevel logistic regression models and the results are summarized in table 27. Illinois 12th graders prescription drug abuse was not significantly influenced by any of these four interactions-school level bullying and student SES, school happiness and student depression, rural location and student SES, perceived availability of ATOD and student gender.

Other measures

Reliability and variances for the models with schools or school districts as level two are summarized in tables 18 and 25 respectively.

Reliability

Reliability is defined as the ratio between the higher level variance component and the sum of the lower level components (Raudenbush & Bryk, 2001). It is the ratio of the true variance to the observed or total variance and has a maximum value of 1 and increases with

sample size of the lower levels. It indicates the ability of the lower level true parameters to estimate between group variations and differentiate higher level units.

The reliability of level 1 intercept was estimated to be <0.001 and that of school level was 0.397 in the null model. The reliabilities obtained from all the four models are summarized and reported in table at the end of this section. Although HLM analysis is still valid even with the low reliability of level 2, coefficients of this level may have to be considered as fixed instead of random in the final model (Raudenbush & Bryk, 2001).

The reliabilities for the intercepts were fair for all drugs (0.360), downers (0.075), uppers (0.302), others (0.399), and steroids (0.511) in the school models. The reliabilities for the intercepts were slightly better for all drugs (0.411), downers (0.209), uppers (0.367), others (0.411), and slightly lower for steroids (0.469) in the school district models.

Multilevel logistic regression results of the different HGLM models are discussed in the following sections.

Model Fit

The measures of model fit are reported in tables 29 and 30. In general, smaller IC values indicate a better model and the model with level-one variables only (model 1) has the lowest values. The addition of or random coefficients (model 2) or cross level interactions (model 3) did not improve the multilevel model. The likelihood ratio test statistics also indicate that model 1 is significantly better than the null model and models 2 and 3. The weighted data used for this study appears to be best suited for US vs. Illinois state comparisons rather than for between group comparisons. Therefore, while there is considerable variation in the prevalence of prescription drug abuse between schools and school districts, none of the level two variables or

the interactions included in the multilevel model were able to significantly explain the observed differences.

Other results

Missing Data Analysis

Results of missing data analysis for dependent variables (table 31); student level predictors (table 32) and school/school district level predictors (table 33). Results indicate that missing data would not have influenced the results in a biased manner.

Multicollinearity

Collinearity statistics including variance inflating factor and tolerance values are reported in table 34. Correlation matrices of school level predictors (table 35) and school district level predictors (table 36) are also reported. Multicollinearity may not be a problem because tolerance is not less than 0.1 and variance inflation factor (VIF) is not greater than 10 for any of the predictors (Schroeder, Lander, & Levine-Silverman, 1990).

Regression

Results of multilevel logistic regression are similar but more precise than those obtained from an ordinary binary logistic regression. Results of binary logistic regression (for the same variables in the model) are provided in table 42 for the purpose of comparison with multilevel logistic regression results (Table 43). Binary logistic results are similar to the multilevel logistic regression results with significance for the same predictors- gender, ATOD use, OTC use, gambling and depression. Multiple regression results for school and school district level predictors are reported in tables 40 and 41 respectively. Multiple regression results for school/school district level predictors are also similar with non-significance for most predictors. Only perceived ATOD availability (b= -0.078, SE=0.037) and community safety (b= 0.087, SE= 0.034) were significant in the school/ school district multiple regression models.

Summary of findings

Prescription drug abuse in Illinois 12th graders was found to be significantly different from prevalence in US 12th graders. Multilevel logistic regression results show that prescription drug abuse in Illinois 12th graders is significantly associated with level one (student) variables such as gender, past year ATOD use, OTC use, gambling, depression, and perceived peer drug use. None of the level two school or school district level variables tested in the different models were significantly associated with prescription drug abuse. Most of the variation in prescription drug abuse appears to be within the schools and school districts and only a little variation exists between schools / school districts.

While most of the variance in prescription drug abuse lies within the schools or school districts, this study made an attempt to measure and interpret the between group variance and identify important school and school district level predictors that can explain that variance. The multilevel analysis is justified because the between group variances are significant and the smaller standard errors and the resulting narrower confidence intervals in an ordinary logistic regression model would have been inaccurate (Sanagou et al., 2012).

CHAPTER 5
DISCUSSION

Introduction

The purpose of this study was to identify individual, family, school and community level factors responsible for the initiation and maintenance of prescription drug abuse behaviors in Illinois 12th grade students. Socio ecological model was chosen as the conceptual framework for this study. Multilevel logistic regression was performed using software such as HLM, STATA and SPSS on 12th graders' prescription drug use data from the 2010 Illinois Youth Survey. Results from these multilevel analyses of prescription drug abuse in Illinois 12^{th} graders and their implications will be discussed in the following sections.

The study findings for each research question are discussed and wherever possible, an attempt is made to compare and contrast the findings of this study with other important national surveys and studies. Study limitations and suggestions for future research and prescription drug abuse prevention programs are then discussed. Conclusion and a summary of important findings of this study are provided at the end of the chapter.

Study findings

In this section, the results of analyses will be discussed in terms of the influence exerted by the predictors in different socio ecological levels. Research questions and hypotheses tested for each socio ecological level are briefly mentioned in the beginning, followed by a discussion of the actual findings. Finally, a comparison of the results from the Illinois Youth Survey and two national studies is included at the end.

Student level predictors

The following five research questions were postulated to test the influence of level one (individual, family and peer) variables on prescription drug abuse.

Research Question 1: Are there any differences in prescription drug abuse patterns by demographic variables such as age, gender, race/ethnicity and socioeconomic status (SES)?

Research Question 2: Does having clear academic/future plans protect Illinois 12th graders against prescription drug abuse?

Research Question 3: Is there a significant relationship between 12th graders' prescription drug abuse and past year alcohol, tobacco and other illicit drug use (ATOD), OTC drug use, gambling and depression?

Research Question 4: Does perceived peer drug use of 12th graders explain 12th graders' prescription drug abuse?

Research Question 5: Do family rules/expectations influence prescription drug abuse of the Illinois 12th graders?

Specifically, it was hypothesized that the odds of prescription drug abuse would be higher in older white male students in 12th grade from a low SES background and having mental health issues, with no college plans, gamble and abuse other substances / OTC drugs, perceive high peer drug use and do not have drug use related family rules. However, only five of the eleven level one predictors tested were found to be significant. Gender, past year depression, past year ATOD use, past year OTC use and gambling were found to be significantly associated with 12th graders prescription drug abuse. Irrespective of the choice of level-two identifier, the multilevel logistic regression results for level-one fixed effects are similar for schools or school districts.

Age

Previous research (Johnston et al., 2011; SAMHSA, 2011) indicated that prescription drug abuse increases with age among school and college students. Since this study considered only 12th grade students, age was not expected to differ much among the overall sample. The

mean age of 12th graders in the sample was 17.64 (SD: 0.63) with a minimum of 16 years and a maximum of 19 years. Although not statistically significant, higher odds of prescription drug abuse were observed in older 12th graders.

Gender

According to the Monitoring the Future study (MTF) (Johnston et al., 2011), although female students have higher use of some drugs like amphetamines in the lower grades, male students in general have higher abuse of almost all prescription drugs by 12th grade. This study confirmed the earlier research findings that males are more likely than females to abuse prescription drugs, especially in the higher grades. Johnston et al. (2011) explain that female students mature earlier and acquire drug abuse behaviors earlier due to association with male students from higher grades. However, by 12th grade males catch up and overtake females in the abuse of many substances including prescription drugs.

Race (White)

Racial differences in prescription drug abuse are well documented in the literature (Harrell & Broman, 2009; Johnston et al., 2011; SAMHSA, 2011). Though statistically significant difference was not observed between Whites and other racial groups at an individual level, higher odds of prescription abuse were seen with a higher proportion of White students in school districts. The result was not significant for White students in the model, probably because of the higher prevalence of prescription drug abuse in the "other race" group. In a model that included race variable with four categories, 12th grade African Americans appear to have fewer odds and 12th grade students belonging to other racial group seem to have higher odds of prescription drug abuse when compared to12th grade White students. Although not significant, Hispanic 12th graders also seem to have lower odds of prescription drug abuse than White 12th

graders. These results are similar to the findings for 12th graders in the Monitoring the Future study (MTF) (Johnston et al., 2012) in which African American and Hispanic 12th grade students were found to be less likely than Whites to abuse prescription drugs. However, the high prevalence of prescription drug abuse in 12th graders belonging to the "other race" group in Illinois is higher than in Whites. This group in Illinois Youth Survey consists of Asian Americans, American Indians, multi-racial individuals and others. McCabe et al. (2007) did a study on racial differences and report that prescription drug abuse, both before and during college, is more likely in Hispanic and White students than Asian and African American students. Thus, Asian Americans in general have lower drug abuse rates, including abuse of prescription drugs. Whereas, according to SAMHSA (2011), among individuals aged 12 or older, Native Hawaiians or Other Pacific Islanders, American Indians or Alaska Natives, and mixed race individuals have higher illicit drug use than individuals belonging to the three major racial groups. Whether, these minority groups also have higher prescription drug abuse is not known. Therefore, 12th graders belonging to the "other race" group in Illinois needs to be followed up closely in future studies.

Low SES

Previous studies have indicated conflicting results about association between socioeconomic status and prescription drug abuse. While the Monitoring the Future study (MTF) used parental education as the proxy measure of student SES (Johnston et al., 2011), this study used eligibility for free lunch as the SES indicator. In this study, uppers abuse was found to be significantly higher in low SES 12th graders. Whether low SES 12th graders abuse uppers more due to higher pressures to obtain scholarships or college funding cannot be determined, but this has to be interpreted with caution due to the lower sample size of strata. Abuse of other

subclasses of drugs or all drugs combined did not have a significant association with SES of 12th graders.

College Plans

It was hypothesized that 12th graders with high academic GPA and having clear college plans would not indulge in prescription drug abuse. McCabe, Boyd, & Teter (2005) found differences in the abuse of opioid analgesics in high school seniors by academic grade. Ford & Arrastia (2008) found differences in the abuse of prescription drug abuse by GPA in college students. However, in this study there were no significant differences observed in the abuse of all prescription drugs and subclasses by GPA or by having college plans. GPA was dropped in the final parsimonious model because of the many strata and lack of significance in the earlier models. Future studies should also examine the impact of absenteeism on prescription drug abuse.

ATOD use, OTC use, Gambling

Past year ATOD use, past year OTC use and gambling were found to be significantly associated with 12th graders prescription drug abuse. Also, poly drug abuse was evident among Illinois 12th graders who abuse prescription drugs, and this may indicate the use of these drugs for non-medical reasons. These results are similar to findings of a previous study done by Boyd, Young, Grey, & McCabe (2009) in which they found significant association between prescription drug abuse and other problem behaviors. Strong association with past year ATOD use, OTC use and gambling may indicate that prescription drug abuse belongs to the cluster of problem behaviors. Indeed, Boyd et al. (2009) were of the opinion that adolescent prescription drug abuse is a problem behavior. In their study on 942 adolescents, they compared four groups: non-users, medical-users, self-treaters and sensation-seekers and found that sensation-seekers

were more likely to abuse prescription drugs. The authors therefore argue that non-medical use of prescription drugs is a newer problem behavior that is gaining popularity.

Depression

Comorbidity of substance abuse and mental health problems has been documented in the literature. While Boyd et al. (2009) did not find a significant relationship between adolescent depression and prescription drug abuse in their study, past year depression was found to be significantly associated with 12th graders prescription drug abuse in this study. However, whether depression is a cause or an effect of prescription drug abuse cannot be determined as this is a cross-sectional study. Higher odds of prescription drug abuse in depressed 12th graders may indicate pharmacological reasons as a motivation for using these drugs, probably as a way to cope with depressed mood.

Family Rules

Family members and friends were found to be the most common sources for prescription drugs abused by 12th graders (Johnston et al., 2012). Family factors were found to be significantly influencing an adolescent's substance abuse in the previous studies (Kumpfer, Alvarado, & Whiteside, 2003; Kumpfer & Bluth, 2004; Vakalahi, 2001). Therefore, it is important to consider family variables in the multilevel model. However, due to the lack of specific variables pertaining to family prescription drugs in the Illinois Youth Survey, only one variable about ATOD related family rules was included in the final model. Results from the analyses of the 2010 Illinois Youth Survey indicate that the abuse of uppers in 12th graders was significantly associated with having clear family rules about ATOD use. Hays et al. (2003) found positive association between 8th graders' ATOD use and single parent families. Future studies should also try to examine the influence of type of family and prescription drug abuse specific

communication and family rules on the abuse behaviors of 12th graders. Significant association between gambling and prescription drug abuse observed in the current study support the need to address adolescent impulsive nature to prevent these problem behaviors.

Peer Drug Use

According to the Monitoring the Future study (Johnston et al., 2011), friends have a greater influence than family on the prescription drug abuse behavior of 12th graders. It was hypothesized that 12th graders who perceive high peer drug abuse would resort to prescription drug abuse. Results indicate that peer drug abuse was significantly associated with prescription drug abuse in 12th graders. However, significant association of perceived peer drug use in the past month and prescription drug abuse in the past year has to be interpreted with caution for two reasons- 1) very few did not mention peer drug use and it is often exaggerated by 12th graders (Center for Prevention Research and Development, 2011b) and 2) while it still may give some indication about the more recent (past month) perceived drug related environment in the schools, doubts will remain about the influence on past year prescription drug abuse in spite of statistical significance.

School level predictors

Research question 6 " Do school level factors such as bullying, presence of a caring teacher /adult, being happy with school, rural/ non rural location, and proportions of low SES students and White students influence the prevalence of prescription drug abuse?" was postulated to examine the influence of school level factors.

At level two, the odds of prescription drug abuse were hypothesized to be higher in schools with a higher proportion of White students and a higher proportion of students reporting

bullying; and a lower proportion of students reporting availability of caring teacher /adult at school, fairness of teachers, being happy, feeling safe, and feeling close to people at school.

Bullying

Bullying in the schools has become a worrisome reality and many schools do not seem to be safe places that foster learning. Past year bullying was reported by every one in five 12th grade students and bullying occurred almost on a daily or weekly basis in one fourth of all public schools during 2008-2009 (CDC, 2012c). In this study, 18.92% of 12th graders reported past year bullying. However, schools with a higher proportion of 12th graders that reported past year bullying do not appear to have higher odds of prescription drug abuse.

Luukkonen, Räsänen, Hakko, & Riala, (2010) did a study on adolescents aged 12-17 years, and reported that bullying behavior was associated with smoking and alcohol use. Gender differences were also observed, with bullying behavior in female adolescents associated with more severe substance use. School level bullying may increase stress levels which can then result in abusing prescription drugs to relieve anxiety and depression. While it is not statistical significant, school level bullying appears to contribute to the between school variation in the prescription drug abuse prevalence and the odds of prescription drug abuse were higher in schools with a higher proportion of 12th graders who reported bullying in the past year. Therefore, attempts should be made to address this issue.

Caring Teacher/Adult

Fletcher, Bonell, & Hargreaves (2008) did a systematic review on the student and school level studies on drug abuse and concluded that school variables such as good teacher-student relationships, engaging the students to make them involved, and promoting a positive school climate would be helpful to counter substance abuse problems in the students.

Based on such previous research, it was hypothesized that schools with a higher proportion of students reporting the presence of a caring teacher or an adult would have lower odds of prescription drug abuse in this study. However, a high percent (89.55%) of Illinois 12th graders acknowledged the presence of a caring teacher or an adult at school and there was no statistically significant relationship observed for any of the prescription drugs abused. This association appears to be close to statistical significance.

School Happiness

Only a little more than half (52.69%) of Illinois 12th graders reported being happy with the school they attend. There was no statistically significant relationship observed between being happy with school and prescription drug abuse at the school level. However, the relationship is in the direction as hypothesized, with 14.5% of unhappy 12th graders and only 7.7% of happy 12th graders reporting prescription drug abuse.

School district level predictors

Research question 7 "Do school district level variables such as perceived community norms, perceived availability of alcohol, tobacco and other drugs, rural/ non rural location, and proportions of low SES students and White students determine prescription drug abuse patterns?" was postulated to test the influence of school district level factors.

At level three, the odds of prescription drug abuse were hypothesized to be higher in rural school districts with higher perceived availability of ATOD drugs.

%Community Norms

Perceived ATOD related community norms can play an important role on the drug abuse behavior of students. It was hypothesized that the odds of prescription drug abuse will be higher in school districts with fewer 12th graders reporting that adult disapproval of ATOD use in their

community. It is assumed that perceived community norms closely reflect the actual social environment in the community in which the student lives.

Overall, majority of students (88%) perceived that adults in their community consider their ATOD use as wrong. School districts with a higher proportion of students reporting adult disapproval of ATOD drug use (Perceived Community Norms) seem to have lower odds of prescription drug abuse but the results were not significant. However, the negative association observed is in accordance with the hypothesis. Approximately, one third of 12th graders, who perceived lack of adult disapproval, abused prescription drugs. Whereas, among those who perceive adult disapproval of ATOD use, only a little more than one tenth abused prescription drugs.

Adult supervision and disapproval of ATOD behavior can reinforce parental supervision and can possibly discourage students from indulging in substance abuse (Hays et al., 2003; Johnston et al., 2011). However, unlike with illicit substances, prescription drugs are abused mostly at home and community norms may have a lesser role and can possibly explain the lack of statistical significance in this study.

ATOD Availability

According to the Monitoring the Future study, perceived drug availability closely approximates the actual availability and trends in the drug abuse prevalence reflect changes in the perceptions related to drug availability. Therefore it was hypothesized that the odds of prescription drug abuse will be higher for school districts in which a higher proportion of 12th graders report easy availability of ATOD drugs.

School districts ranged from 77% to almost 100% in terms of easy availability of ATOD (as reported by the 12th graders). Among those who did not perceive easy availability, only 2.4%

abused prescription drugs, where as 12.6 % of those who perceived easy availability abused these drugs. The odds of prescription drug abuse appeared to be nearly six times higher in students who perceived easy availability of ATOD drugs. However, contrary to expectations, school districts with a higher proportion of 12th graders reporting easy ATOD availability did not have significantly higher odds of prescription drug abuse.

Community Activities

Participation in extracurricular and community activities may be a prerogative of the students. However, if a high proportion of students participate in community activities, it is also a measure of the communities' ability to engage the students in productive activities.

Overall, 81.4% of 12^{th} graders participate in school activities. However, there were some school districts in which nearly 44% of 12^{th} grade students did not participate in community activities. As expected a higher proportion of students who did not participate in community activities indulged in prescription drug abuse. Among those participating in community activities, less than 10% abused prescription drugs, where as 14.3% of those who did not participate in community activities abused these drugs.

Although statistically significant results were not obtained, school districts with a higher proportion of students reporting having opportunities for participation in community activities seems to have lower odds of prescription drug abuse.

Neighborhood Safety

Concerns about neighborhood safety may also discourage students from engaging in community activities at school or in the community. Staying at home for long periods, especially without supervision, can lead to increased media time and indulging in prescription drug abuse,

possibly out of boredom. Therefore, it was hypothesized that the odds of prescription drug abuse will be higher in school districts with a higher proportion of 12th graders reporting safety issues.

Nearly one third of 12th graders belonged to school districts considered as unsafe in the sample. Among 12th graders reporting unsafe communities, less than 13.7 % abused prescription drugs; whereas 11% of those from safe communities abused these drugs. Contrary to expectations, school districts with a higher proportion of 12th graders reporting safety issues do not have significantly higher odds of prescription drug abuse.

Level two- aggregated demographic variables

The influence of certain demographic factors such as SES may be different at a higher hierarchical level than at the individual level. Therefore, race, SES and location of 12th graders were aggregated and included as level two variables.

Race

Since national studies such as the Monitoring the Future study (Johnston et al., 2011) and National Study of Drug Use and Health (SAMHSA, 2011) have shown that prescription drug abuse is higher in White adolescents, it was hypothesized that schools / school districts with a higher proportion of White 12th graders will have higher odds of prescription drug abuse. While the proportion of White students at the school district level appears to be associated with prescription drug abuse, this aggregate variable was found to be not significant at the school level.

Low SES

It was hypothesized that schools / school districts with a higher proportion of low SES 12th graders will have higher odds of prescription drug abuse. In this study the proportion of low SES students at the school/school district level did not appear to be associated with prescription drug abuse. It is possible that access to physicians or pharmacies may mediate the relationship

between prescription drug abuse and SES. Therefore, future studies should also account for the health insurance status of the students and their families to better understand the influence of SES.

Rural / non-rural location

Previous studies have shown that the abuse of many substances is higher in rural adolescents. Therefore, it was hypothesized that rural schools / school districts will have higher odds of prescription drug abuse.

Only five out of thirty four school districts were rural in the study sample. In general, schools / school districts in the Chicago area appear to have lower odds of prescription drug abuse when compared to school districts in other regions. Bivariate analysis shows that a 12th grader from Suburban Chicago and Urban/Suburban areas has significantly higher odds of prescription drug abuse than those from Chicago. The location of the school/school district, as indicated by the four community areas, appears to contribute considerably to the between cluster variation in prescription drug abuse. However, the results of the multilevel model with dichotomous location variable indicate that rural schools / school districts do not have significantly higher odds of prescription drug abuse than non-rural schools / school districts.

Differences in Prevalence- Illinois vs. US

Overall, the results indicate that Illinois 12th graders (11.4%) have a lower prevalence than US 12^{th} graders (15.4%) in the 2010 Monitoring the Future study sample. The lifetime prevalence among Illinois 12^{th} graders (19.1%) is also lower than their US counterparts (25.6%) according to the 2011 Youth Risk Behavior Surveillance System (YRBSS) report. Illinois is in the lower quartile of states with respect to prescription drug abuse prevalence. Illinois male (14.2% vs.16.1%), female (8.9% vs. 13.7%) and White (11.5% vs. 17.5%) 12th graders have lower prevalence than their US counterparts.

Many of these differences are significant and the reasons responsible should be examined in detail in the future studies. Prescription drug abuse was found to be significantly associated with ATOD use in the Illlinois 12th graders in this study and a similar mechanism may be operating at the macro level leading to these differences. For example, south had the lowest and northeast region had the highest prevalence of Illicit substance use, according to the Monitoring the Future study (Johnston et al., 2011). Previous studies (Manchikanti, 2007) also indicated a higher prescription drug abuse related mortality in states with higher percent of rural population. Therefore, geographic variation in the prevalence of ATOD use at state level or other factors such as differences in drug policies, the number of substance abuse prevention programs available for a defined population, and overall ATOD availability can possibly explain prescription drug abuse differences between Illinois and US and should be studied in greater detail in the future studies.

Importance of socio ecological approach in the study of prescription drug abuse

There is sufficient evidence in the literature about socio ecological influences on substance abuse that justify multilevel study of prescription drug abuse. For example, Kumpfer & Turner (1990) applied Social Ecology Model to study substance abuse in high school students and recommended that prevention programs should try to improve self-efficacy, peer relations, family climate, school climate and school bonding. In a study done by Connell, Gilreath, Aklin, & Brex (2010) on 9th and 10th grade students (n=1200) from non-metropolitan schools in New England, it was found that differences in substance abuse patterns were explained by individual variables such as gender, antisocial behavior, academic performance and perceived harm from use; family variables such as parental drinking and parental disapproval of drug use; and

community variables such as substance availability. Peer substance use, as reported by the study participants, was found to be the most important variable that explained substance abuse in this study. It is important to study substance abuse from a socio ecological perspective and understand community and social context of individual substance abuse behaviors (Wallace Jr, 1999).

Geoffrey Rose (1985) considered population approach as behaviorally appropriate and mentions that while individual approach for changing behaviors is necessary in the short term, changing social norms will be more beneficial for those changes to sustain and be cost effective in the long term. The role of contextual factors will get ignored with the approach that aims only to identify high risk groups and therefore eco epidemiological analysis of outcome and predictors that exert influence within and between groups is necessary (Susser & Susser, 1996). Every individual uses prescription drugs at some point in life and almost every home has prescription drugs or over the counter drugs. When the exposure to prescription drugs is ubiquitous and every individual in the population is exposed, it is almost impossible to define a population at risk.

The aim of this study was not to prove that one approach is better than the other but to identify both individual and contextual factors that can be modified to curb the prescription drug abuse in Illinois 12th graders. This is one of the few studies that used socio ecological model to study prescription drug abuse and probably the first study to use multilevel logistic regression to analyze the prescription drug abuse data from Illinois schools. The advantage with such a socio ecological approach to prescription drug abuse is that comprehensive interventions can be planned to address significant factors identified in different levels. While the level two predictors accounted for very little variance in the prescription drug abuse of Illinois 12th graders in this study, the presence of significant variation in prescription drug abuse between schools and

school districts justify the application of social ecological model and analyzing the data with multilevel logistic regression.

Due to the lack of research on contextual factors related to prescription drug abuse, it is important to plan more multilevel studies to provide evidence based guidelines for prevention programs. Especially, the role of factors from higher socio ecological levels such as drug abuse policies, school drug abuse education and prevention programs, social networking and media should be examined in future studies.

Limitations

The most important limitation from an epidemiological point of view is the inability to determine temporality and causality because of the cross sectional study design.

Although, specially designed studies are required for data collection from multiple levels, secondary data was used in this study. Therefore, power may not have been sufficient to detect association between the variables of interest. Multilevel studies typically need more data at higher levels. Due to the lack of adequate number of level two units (schools), school districts were not included as level three in this study. Instead two separate two level logistic regression analyses were conducted with schools and school districts as level two units in different models to study the influence of the predictors in these levels.

Aggregated measures were used as variables for school and school district levels only as a convenience for multilevel data analysis and may not capture all the related information at these levels. Not all possible interactions of individual, school, and community factors were included due to data constraints. One major limitation was the inability to study specific peer and family factors responsible for diversion of prescription drugs.

The data for this study are self-reported and are therefore subject to biases such as those resulting from memory recall. The responses also cannot be verified for truth. Previous research showed some similarities as well differences in the results of drug abuse studies based on self-report measures and on bioassays (Harrison, 1997). Therefore doubts about the accuracy remain and even if majority of students reported honestly, recall bias cannot be excluded. Recall bias about prescription drug abuse initiation is actually more likely to occur with 12th grade students than with those in lower grades (Johnston et al., 2011). However, prescription drugs are not illicit like other commonly abused illicit substances and therefore the respondents may not feel stigma attached for reporting their use.

Despite some reservations about the use of free lunch as an indicator of student SES (Harwell & LeBeau, 2010), this study used it as a proxy variable at both individual and school level in the analyses, as no other information related to SES is collected in the Illinois Youth Survey.

DSM criteria were not used to define substance abuse or depression. Inability to differentiate the prescription drug abuse for pharmacological (self- medication)/recreational purpose is an important limitation of this study as motivations for abuse, health insurance status/access to medical care, all of which can influence non-medical use of the prescription drugs (Boyd et al., 2009), are not known for this sample. Also frequency of usage was not taken into consideration due to data and design limitations.

The results of this study are generalizable only to 12th graders in Illinois. While there are differences in state specific drug abuse policies, prescription drug monitoring programs and the classes of substances monitored; the influence of school and school district level contextual factors such as bullying may be similar in other US states. Therefore, in spite of the limitations in

generalizability beyond Illinois, this study can probably help similar studies in other regions by allowing comparison of similarities and differences in demographic characteristics of the populations, prevalence of the prescription drug abuse, and the distribution of contextual factors.

The choice of socio ecological framework was not without some methodological challenges. Most importantly, research based evidence about the influence of distal risk factors of their interactions on adolescent prescription drug abuse is scanty. Therefore, generating hypotheses for multilevel research on prescription drug abuse was a difficult task (Sallis et al., 2008). Also, distal factors such as substance abuse policies and school climate may not vary much across the schools in Illinois and this may have underestimated the role of contextual factors.

Although ecological models have the advantage of a comprehensive approach, practical utility can be low (Sallis et al., 2008). Also, distal factors are not easily amenable for a change. Therefore, even if a study identifies significant distal risk, developing prescription drug abuse prevention programs will remain a challenge. Ecologic and cross-level bias, confounding, within-group misclassification, insufficient data, problems with temporality, collinearity, and migration across groups are some of the problems with ecological studies in epidemiology (Morgenstern, 1995).

Implications

Prescription drug abuse has become an important public health problem, especially in the school students. National studies such as the Monitoring the Future survey and National Survey on Drug Use and Health (NSDUH) may not detect regional abuse patterns and trends. Therefore, there is a need for designing and conducting specific studies to understand this growing problem. For example, the higher prevalence in the “other” racial group than in White students is a surprise finding in this study. Prescription drug abuse epidemic may still be evolving in the sub

groups and as such the “high risk” groups may be changing with time. Therefore, it may be necessary to plan regional studies for specific sub groups.

Future Illinois Youth Surveys should consider including a separate item for opioid analgesics, due to the high prevalence in the abuse of these drugs. Also, including questions about similar prescription drugs as in the Monitoring the Future questionnaire allows for direct comparison of the trends of prescription drug abuse in Illinois with the national estimates. Questions should also be included to learn more about sources, reasons for abuse and parental communication specific to prescription drug abuse.

Supply control has been the mainstay of national drug policy and several laws such as Harrison act, the federal controlled substances act, the drug abuse prevention and control act, and the Harold Rogers prescription drug monitoring program were passed in this regard (Califano Jr & Bollinger, 2005). However, the supply control strategies may be less effective than demand reduction strategies in case of prescription drug abuse, because the main sources for these drugs are friends and family (Johnston et al., 2011).

Prescription Drug Monitoring Programs have become an import part of abuse prevention policy. However, only 35 US states have prescription drug monitoring programs (PDMP) and there are also differences in the state PDMPs with respect to the controlled substances monitored (Manchikanti, 2006). For example, only schedule II drugs are monitored by Illinois PDMPs. States that do not have these programs should explore options for implementing PDMPs. In addition to the interstate communication of electronic prescription monitoring information, a uniform system with respect to the substances controlled by enforcement may also help.

Electronic prescription monitoring can identify doctor shoppers and illegal prescribers and is more accurate than self-report data in certain aspects. However, adolescent abusers who

obtain the prescription drugs from parents and friends may not be identified by electronic prescription monitoring. While the number of adolescents who obtain prescription drugs from online pharmacies is low, this group is also unlikely to be identified by the electronic prescription monitoring.

The National Drug Control Strategy mainly focuses on the reduction of prescription psychotherapeutic abuse ("Prescription Drug Abuse | The White House," 2011). While it is true that the abuse of drugs such as steroids has decreased and students use these drugs for different reasons, but even they can result in dangerous changes in mental state with prolonged use. Irrespective of the type of drug abused, prescription drug abuse is therefore a problem for not only the students who abuse these drugs but it also puts everyone in their vicinity at risk. Prescription drug abuse prevention programs may have to pay special attention to 12th graders with other problem behaviors such as gambling, ATOD use, and OTC drug use. Since depression was found to be significantly related to prescription drug abuse, schools should provide counseling and mental health support wherever possible.

Family ATOD rules were not significantly associated with prescription drug abuse in this study and this could be due to the lack of specific information related to prescription drugs in the parent and child communication. Most parents do not communicate about the dangers of prescription drug abuse as they do with illicit substances. Parental, peer and teacher education to prevent diversion is therefore an important area for intervention also because friends and family are the most common sources for prescription drugs abused by 12th graders (Johnston et al., 2011). School drug abuse prevention programs also focus mainly on illicit substances. School districts with fewer opportunities for community activities for the students may be at higher risk of prescription drug abuse. For these reasons, demand reduction strategies that place importance

on education may be more effective than supply control and enforcement for prevention of prescription drug abuse in Illinois 12th graders.

Conclusion

Prescription drug abuse has reached epidemic proportions and is now second only to the abuse of marijuana. Although the rates in Illinois are lower than the national rates, a significant number abuse prescription drugs. Especially, the lack of knowledge about the harmful long term consequences and association with future illicit substance use is disturbing. Young adults in colleges are the group with highest risk for prescription drug abuse (Johnston et al., 2011). In this regard, 12th graders are an important demographic because they are in a transition phase and a majority will soon be entering college. Many of the substance abuse behaviors that are initiated at this stage can continue as lifelong patterns. Therefore, it is important to study prescription drug abuse in 12th graders.

Many of the previous studies examined prescription drug use either at an individual level or at higher ecological levels. This study made an attempt to find out if individual and contextual factors were associated with of prescription drug abuse in Illinois 12th grade students. Socio ecological framework was used as the conceptual framework and both individual and school / school district levels were incorporated in the analyses to estimate both fixed and random effects. Results indicate that 12th graders who abuse other substances and OTC drugs, gamble and are depressed have higher odds of prescription drug abuse. Drug abuse prevention programs should seek to actively address mental health issues of the students. Efforts should also be made to address bullying at the school level to create a safe environment that is conducive to learning and develop. Supply reduction strategies and policies aimed at reducing availability of ATOD at the school district level may also help.

This study data did not support any of the research hypotheses postulated for socio ecological level two. Although it appears as if contextual factors for prescription drug abuse are not as important as in the case of illicit substance use, "absence of evidence is not evidence of absence" (Altman & Bland, 1995). The variables included in the model from those available in the data were able to explain only a small amount of the prescription drug abuse variation that exists between the level 2 units. As this study used secondary data that was not collected specifically for multilevel analyses, due to the relatively smaller sample size at higher levels power may not have been sufficient to detect statistical significance of the hypothesized associations.

With current economic downturn and recession, at a time when governments are considering legalizing illegal drugs like marijuana for the tax revenue that it can possibly generate and people voting in favor of such measures to lift restrictions, recommending changes in drug policies for allocation of additional resources and requesting funds for tighter control on legal drugs could be a difficult task. Nevertheless it is important to continue the efforts to educate students about dangers. Parents, teachers and health care practitioners should also be trained to recognize the signs of abuse early and communicate properly about the risks involved with prescription drug abuse. It is also important to address the narcotic analgesic prescribing habits of the physicians to satisfy patients seeking of pain prescriptions for even mild pain. While there is no need to suffer when there are medicines, for example to relieve physical pain or psychological distress, whether the current high usage of these drugs reflects their genuine need is questionable.

In conclusion, this study examined prescription drug abuse in the context of multilevel determinants. This study identified important individual level factors and confirmed significant

variation in prescription drug abuse between communities. The finding of significant between school and school district variation in the prescription drug abuse underscores the importance of considering factors operating at higher socio ecological levels in studies on the 12th graders' prescription drug abuse. Therefore, this study can possibly serve as a template for future etiological, intervention or prevention studies that try to identify important multilevel risk factors and develop programs aimed at decreasing prevalence of prescription drug abuse in the 12th graders.

TABLES

Descriptive Statistics

Table 1- 2009 Illinois 12th Graders' Prescription Drug Abuse Prevalence

Variable	Categories	n	%
Prescription Drug Abuse (U 12)	No	1375	88.6
	Yes	**177**	**11.4**
Steroid Abuse	No	1534	98.8
	Yes	**18**	**1.2**
Uppers Abuse	No	1458	93.9
	Yes	**94**	**6.1**
Downers Abuse	No	1459	94
	Yes	**93**	**6**
Other Prescription Drug Abuse	No	1424	91.8
	Yes	**128**	**8.2**

Table 2- Prescription drug abuse trends among Illinois 12th graders, 2004-2009

	2004	2006	2008	2010
Uppers	5.8%	5.4%	4.1%	5.8%
Downers	5.4%	5.2%	4.5%	5.9%
Steroids	1.2%	0.9%	0.8%	1.2%
Other Drugs	14.3%	13.7%	6%	7.7%

Table 3- 2009 Prevalence among 12th graders: US vs. Illinois

	Categories	Illinois	US
Total Prevalence		11.4%	15.4%
Gender	Female	8.9%	13.7%
	Male	14.2%	16.1%
Race	White	11.5%	17.8%
	African American	7.3%	7.3%
	Hispanic	9.7%	9.9%
College Plans	No	8.4%	20%
	Yes	11.1%	13.8%

Table 4- Descriptive Statistics- Level one (Student)

Variable	Categories	n	%
Age		17.64 (mean)	0.63 (SD)
Gender	Female	725	46.99
	Male	818	53.01
Race	White	948	61.40
	African American	232	15.03
	Hispanic	216	13.99
	Other	148	9.59
Race (White)	No	489	33.93
	Yes	952	66.07
Low SES	No	1012	65.54
	Yes	532	34.46
College Plans	No	107	6.9
	Yes	1278	82.5
ATOD use	No	494	32.20
	Yes	1040	67.80
OTC drug use	No	1268	81.70
	Yes	284	18.30
Gambling	No	1037	68.49
	Yes	477	31.51
Depression	No	1176	78.04
	Yes	331	21.96
Suicidal thoughts	No	1288	86.97
	Yes	193	13.03
Peer Drug Use (past month)	No	23	1.48
	Yes	1529	98.52
Family Rules	No	364	24.64
	Yes	1113	75.36

Table 5- Descriptive Statistics-Level two (Schools)

	Mean	Median	Std. Deviation	Minimum	Maximum
Bullying	18.92%	18.42%	7.41%	4.00%	40.00%
School Adult Support / Care	89.55%	90.70%	6.59%	67.00%	98.00%
Fair teachers	49.79%	50.00%	15.53%	23.00%	81.00%
Feel close to people at school	58.18%	56.76%	12.05%	34.00%	88.00%
Feel safe at school	69.75%	71.79%	19.94%	30.00%	100.00%
Happy with school	52.69%	51.61%	14.38%	19.00%	81.00%

Table 6- Descriptive Statistics-Level two (School districts)

	Minimum	Maximum	Mean	Std. Deviation
Perceived Community Norms towards ATOD	88.00%	100.00%	96.77%	3.10%
Participation in Community Activities	56.00%	100.00%	81.40%	8.68%
Community Safety	67.00%	100.00%	87.05%	11.42%
Rural / Non-Rural	0.00%	100.00%	11.94%	32.43%
ATOD Availability	77.14%	97.44%	89.54%	5.149%

Table 7- School districts by Community type

	n	%
Chicago	1	2.9
Suburban Chicago	18	52.9
Urban/Suburban	10	29.4
Rural	5	14.7

Bivariate Analyses

Table 8- Crosstabs (Level One Independent Variables x Prescription Drug Abuse)

Variable	Categories	Prescription Drug Abuse		Chi-Square (df)	P-value
		Yes n (%)	No n (%)		
Gender	Female	73 (8.90%)	745 (91.10%)	10.61 (1)	**0.001**
	Male	103 (14.20%)	622 (85.80%)		
Race (White)	No	66 (11.10%)	530 (88.90%)	0.043 (1)	**0.836**
	Yes	108 (11.4%)	838 (88.60%)		
Low SES	No	122 (12.10%)	890 (87.90%)	1.81 (1)	0.178
	Yes	52 (9.80%)	480 (90.20%)		
College Plans	No	9 (8.4%)	98 (91.6%)	0.741 (1)	0.389
	Yes	142 (11.1%)	1136 (88.9%)		
Depression	No	106 (9.0%)	1070 (91%)	21.886 (1)	**<0.001**
	Yes	60 (18.1%)	271 (81.9%)		
ATOD use	No	10 (2.00%)	484 (98.00%)	60.11 (1)	**<0.001**
	Yes	159 (15.30%)	881 (84.70%)		
OTC drug use	No	78 (6.20%)	1190 (93.80%)	189.26 (1)	**<0.001**
	Yes	99 (34.90%)	185 (65.10%)		
Gambling	No	87 (8.4%)	950 (91.6%)	23.390 (1)	**<0.001**
	Yes	80 (16.8%)	397 (83.2%)		
Peer Drug Use (past month)	No	1 (4.30%)	22 (95.70%)	1.15 (1)	0.283
	Yes	176 (11.50%)	1353 (88.50%)		
Family rules	Yes	107 (9.60%)	1006 (90.40%)	14.90 (1)	**<0.001**
	No	62 (17.00%)	302 (83.00%)		

Bold letters indicate statistical significance

Table 9- Crosstabs (School Level Independent Variables x Prescription Drug Abuse)

Variable	Categories	Prescription Drug Abuse		Chi-Square (df)	P-value
		Yes n (%)	No n (%)		
Bullying	No	130 (10.60%)	1094 (89.40%)	1.666 (1)	0.197
	Yes	38 (13.30%)	248 (86.70%)		
School Adult Support / Care	No	24 (15.30%)	133 (84.70%)	3.461 (1)	0.063
	Yes	141 (10.40%)	1215 (89.60%)		
Fair teachers	No	112 (14.90%)	642 (85.10%)	25.418 (1)	**<0.001**
	Yes	51 (6.80%)	701 (93.20%)		
Feel close to people at school	No	85 (13.50%)	544 (86.50%)	7.749 (1)	**0.005**
	Yes	79 (9.00%)	800 (91.00%)		
Feel safe at school	No	52 (11.60%)	397 (88.40%)	.563 (1)	0.453
	Yes	108 (10.30%)	943 (89.70%)		
Happy with school	No	103 (14.50%)	607 (85.50%)	18.041 (1)	**<0.001**
	Yes	61 (7.70%)	734 (92.30%)		

Bold letters indicate statistical significance

Table 10- Crosstabs (School District Level Independent Variables x Prescription Drug Abuse)

Variable	Categories	Prescription Drug Abuse		Chi-Square (df)	P-value
		Yes n (%)	No n (%)		
Perceived Community Norms towards ATOD	Not wrong	16 (32.70%)	33 (67.30%)	22.40(1)	**<0.001**
	Wrong	158 (10.80%)	1311 (89.20%)		
Community Activities	No	33 (14.30%)	197 (85.70%	4.63(1)	**0.032**
	Yes	97 (9.50%)	919 (90.50%)		
Easy Availability of ATOD	No	4 (2.40%)	160 (97.60%)	14.77 (1)	**<0.001**
	Yes	171 (12.60%)	1190 (87.40%)		
Safe Community	No	27 (13.70%)	170 (86.30%)	1.22 (1)	0.269
	Yes	147 (11.00%)	1186 (89.00%)		
Rural School District	No	160 (11.70%)	1205 (88.30%)	1.53 (1)	0.216
	Yes	16 (8.60%)	169 (91.40%)		
Community Type	Chicago	16 (6.70%)	223 (93.30%)	11.21 (3)	**0.011**
	Suburban Chicago	88 (11.70%)	661 (88.30%)		
	Urban/Suburban	56 (14.90%)	321 (85.10%)		
	Rural	16 (8.60%)	169 (91.40%)		

Bold letters indicate statistical significance

Table 11- Crude OR (Level One Independent Variables x Prescription Drug Abuse)

Independent Variables	Crude OR	95% CI		P-value
		Lower	Upper	
Age	1.025	0.775	1.355	0.864
Gender	**1.69**	**1.229**	**2.323**	**0.002**
Race	0.942	0.672	1.321	0.73
Low SES	0.79	0.561	1.114	0.178
College Plans	1.361	0.673	2.754	0.391
ATOD (past year)	**8.735**	**4.567**	**16.708**	**<0.001**
OTC (past year)	**8.164**	**5.842**	**11.41**	**<0.001**
Depression	**2.235**	**1.585**	**3.151**	**<0.001**
Gambling	**2.2**	**1.589**	**3.047**	**<0.001**
Family rules	**1.93**	**1.376**	**2.707**	**<0.001**
Peer Drug Use (past month)	2.862	0.383	21.362	0.283

Bold letters indicate statistical significance

Table 12- Crude OR-Race (4 categories) x Prescription Drug Abuse

	Crude OR	95% C.I		P-value
		Lower	Upper	
African American Vs. White	**0.61**	**0.36**	**1.04**	**0.07**
Hisp Vs. White	0.83	0.51	1.36	0.46
Others Vs. White	**1.80**	**1.14**	**2.84**	**0.01**

Bold letters indicate statistical significance

Table 13- Crude OR (School variables x Prescription Drug Abuse)

	Crude OR	95% CI		P-value
		Lower	Upper	
Bullying	1.29	0.88	1.90	0.198
School Adult Support / Care	0.64	0.40	1.03	0.065
Fair teachers	**0.42**	**0.29**	**0.59**	**<0.001**
Feel close to people at school	**0.63**	**0.46**	**0.88**	**0.006**
Feel safe at school	0.87	0.62	1.24	0.453
Happy with school	**0.49**	**0.35**	**0.68**	**<0.001**

Bold letters indicate statistical significance

Table 14- Crude OR (School district variables x Prescription Drug Abuse)

	Crude OR	95% C.I		P-value
		Lower	Upper	
Perceived Community Norms towards ATOD	**0.249**	**0.134**	**0.462**	**<0.001**
Community Activities	**0.63**	**0.412**	**0.963**	**0.033**
Easy Availability of ATOD	**5.748**	**2.104**	**15.703**	**0.001**
Community Safety	0.78	0.502	1.213	0.27
Rural location	0.713	0.416	1.222	0.218
Community Type				
(Suburban Chicago / Chicago)	**1.856**	**1.066**	**3.229**	**0.029**
(Urban/Suburban / Chicago)	**2.431**	**1.36**	**4.348**	**0.003**
(Rural / Chicago)	1.32	0.642	2.714	0.451

Bold letters indicate statistical significance

Multilevel Logistic Regression

Table 15- Descriptive statistics for prescription drug subclasses

Dependent Variables	N	Mean	SD	Min	Max
All	1550	0.11	0.32	0	1
Downers	1550	0.06	0.24	0	1
Uppers	1550	0.06	0.24	0	1
Others	1550	0.08	0.27	0	1
Steroids	1550	0.01	0.11	0	1

Table 16- Descriptive statistics for level-one predictors

Independent Variables (Level one)	N	Mean	SD	Min	Max
Age	1550	17.65	0.56	16	19
Gender	1541	0.53	0.5	0	1
Race	1542				
White		0.61	0.49	0	1
African Americans		0.15	0.36	0	1
Hispanics		0.14	0.35	0	1
Others		0.1	0.29	0	1
Low SES	1542	0.34	0.48	0	1
College Plans	1385	0.92	0.27	0	1
ATOD	1532	0.68	0.47	0	1
Gambling	1514	0.32	0.46	0	1
OTC	1550	0.18	0.39	0	1
Depression	1507	0.22	0.41	0	1
Family Rules	1475	0.75	0.43	0	1
Peer Drug Use	1550	0.99	0.12	0	1

HGLM 2 level Analyses (students, schools)

Table 17-Descriptive statistics of level 2 predictors for the models with schools as level two

Independent Variables (Level two)	N	Mean	SD	Min	Max
Bullying	42	0.19	0.07	0.04	0.4
Caring Teacher/Adult	42	0.9	0.07	0.67	0.98
Happy with school	42	0.52	0.15	0.19	0.81
Rural / Non-Rural	42	0.12	0.33	0	1
White students	42	0.6	0.33	0	0.98
Low SES	42	0.36	0.29	0.02	1

Table 18- Reliability and variances for the models with schools as level two

	Reliability	**Sigma squared (σ^2)**	**Tau (τ)**	**df**	**Chi-square**	**P-value**
All	0.360	0.939	0.148	41	64.550	**0.011**
Downers	0.075	0.972	0.038	41	43.518	0.364
Uppers	0.302	0.897	0.194	41	58.033	**0.041**
Others	0.399	0.899	0.228	41	70.961	**0.003**
Steroids	0.511	0.427	1.709	41	132.171	**<0.001**

Bold letters indicate statistical significance

Table 19- Measures of heterogeneity for the models with schools as level two

	ICC	**MOR**	**P-value**
All	0.043	1.441	**0.011**
Downers	0.011	1.205	0.364
Uppers	0.056	1.520	**0.041**
Others	0.065	1.574	**0.003**
Steroids	0.342	3.462	**<0.001**

Bold letters indicate statistical significance

Table 20- Beta coefficients (SE) for the models with schools as level two

Fixed Effect	All B (SE)	Downers B (SE)	Uppers B (SE)	Others B (SE)	Steroids B (SE)
Intercept	**-3.069** **(0.846)**	-116.500 (1937721.486)	-36.215 (519431.674)	**-3.358** **(0.679)**	-27.253 (192.004)
%Bullying	1.551 (1.010)	-0.324 (2.442)	1.316 (2.247)	1.183 (1.344)	10.951 (7.146)
%Caring Teacher/Adult	1.876 (1.946)	3.729 (3.635)	-1.061 (3.312)	0.002 (2.857)	-0.119 (8.864)
%Happy with school	-1.492 (1.001)	-3.532 (1.922)	-1.105 (1.756)	-0.462 (1.195)	-2.441 (5.570)
Rural/Non-rural	-0.534 (0.427)	-0.606 (0.760)	-0.194 (0.618)	-0.017 (0.769)	-10.761 (63.457)
%White students	**1.072** **(0.494)**	-0.269 (1.078)	0.940 (0.893)	0.335 (0.579)	2.013 (2.724)
% Low SES	-0.078 (0.766)	-1.360 (1.206)	-1.810 (1.077)	-0.025 (0.965)	-0.330 (3.595)
Age	0.113 (0.153)	0.257 (0.331)	0.209 (0.190)	0.324 (0.202)	**1.724** **(0.659)**
Gender	**-0.477** **(0.168)**	-0.239 (0.395)	**-0.516** **(0.221)**	**-0.523** **(0.208)**	-0.897 (0.693)
Race (White)	0.088 (0.257)	0.413 (0.487)	0.399 (0.266)	0.173 (0.242)	-0.401 (0.771)
Low SES	0.181 (0.298)	(0.257 (0.482)	0.564 (0.258)	-0.005 (0.262)	-0.190 (0.764)
College Plans	0.396 (0.486)	-0.109 (0.695)	0.888 (0.471)	0.573 (0.455)	11.026 (58.997)
ATOD	**1.806** **(0.378)**	**2.291** **(0.942)**	**3.000** **(0.695)**	**1.618** **(0.373)**	**10.031** **(33.274)**
Gambling	**0.521** **(0.204)**	0.598 (0.377)	**0.744** **(0.207)**	**0.525** **(0.240)**	0.940 (0.593)
OTC	**1.802** **(0.196)**	**2.071** **(0.358)**	**2.200** **(0.198)**	**1.670** **(0.223)**	1.748 (0.538)
Depression	**0.867** **(0.261)**	**0.758** **(0.387)**	**0.639** **(0.222)**	**0.968** **(0.280)**	0.607 (0.640)
Family Rules	-0.314 (0.252)	-0.190 (0.370)	**-0.527** **(0.201)**	-0.261 (0.225)	1.475 (0.797)
Peer Drug Use	-1.643 (0.895)	110.438 (1937721.48)	28.332 (519431.670)	**-1.848** **(0.804)**	-1.316 (185.934)

Bold letters indicate statistical significance

Table 21- Odds Ratios (95% CI) for the model with schools as level two

Fixed Effect	All	Downers	Uppers	Others	Steroids
	OR 95% CI	**OR 95% CI**	**OR 95% CI**	**OR 95% CI**	**OR 95% CI**
Intercept	0.046 (0.004,0.569)	<0.001 -	<0.001 -	0.035 (0.009,0.138)	<0.001 -
%Bullying	4.723 (0.165,135.053)	0.724 (0.108,4.832)	3.727 (0.039,356.886)	3.265 (0.213,49.957)	57098.228 -
%Caring Teacher/Adult	6.629 (0.043,1014.978)	41.555 (0.667,2589.671)	0.346 (-,287.749)	1.002 (0.003,330.667)	0.884 (-,9082701.988)
%Happy with school	0.222 (0.015,3.360)	0.029 (0.002,0.501)	0.331 (0.009,11.702)	0.630 (0.056,7.126)	0.087 (-,1500.570)
Rural/Non-rural	0.585 (0.215,1.597)	0.546 (0.170,1.752)	0.824 (0.235,2.888)	0.983 (0.206,4.688)	0.003 (-,0.054)
%White students	2.921 (0.667,12.795)	0.764 (0.140,4.160)	2.559 (0.417,15.693)	1.398 (0.432,4.529)	7.479 (0.029,1915.184)
% Low SES	0.918 (0.169,4.975)	0.256 (0.045,1.461)	0.164 (0.018,1.457)	0.975 (0.137,6.912)	0.719 (0.001,429.234)
Age	1.120 (0.755,1.661)	1.294 (0.816,2.051)	1.233 (0.850,1.789)	1.383 (0.931,2.053)	5.606 (0.678,46.335)
Gender	**0.621 (0.386,0.998)**	0.787 (0.474,1.308)	**0.597 (0.387,0.921)**	**0.592 (0.394,0.890)**	0.408 (0.085,1.959)
Race (White)	1.091 (0.609,1.955)	1.511 (0.739,3.090)	1.490 (0.885,2.510)	1.189 (0.739,1.911)	0.670 (0.170,2.642)
Low SES	1.199 (0.668,2.153)	1.293 (0.596,2.805)	**1.758 (1.060,2.913)**	0.995 (0.595,1.663)	0.827 (0.160,4.267)
College Plans	1.488 (0.595,3.721)	0.897 (0.292,2.752)	2.430 (0.965,6.118)	1.773 (0.726,4.328)	**411.601 (100.842,1680.012)**
ATOD	**6.095 (2.708,13.717)**	**9.887 (2.316,42.214)**	**20.077 (5.142,78.385)**	**5.041 (2.425,10.479)**	**152.764 (73.377,318.042)**
Gambling	**1.684 (1.069,2.655)**	1.818 (1.048,3.153)	**2.105 (1.403,3.157)**	**1.691 (1.057,2.705)**	2.560 (0.611,10.725)
OTC	**6.081 (3.952,9.358)**	**7.935 (4.787,13.152)**	**9.027 (6.120,13.317)**	**5.314 (3.430,8.234)**	5.739 (1.023,32.189)
Depression	**2.381 (1.475,3.844)**	**2.134 (1.153,3.950)**	**1.894 (1.225,2.929)**	**2.633 (1.521,4.559)**	1.835 (0.377,8.920)
Family Rules	0.730 (0.463,1.151)	0.827 (0.434,1.574)	**0.591 (0.398,0.875)**	0.770 (0.496,1.197)	4.373 (0.207,92.607)
Peer Drug Use	0.192 (0.018,2.075)	166968.571 -	15787895425 -	**0.158 (0.033,0.761)**	0.274 (0.101,0.742)

Bold letters indicate statistical significance

HGLM 2 level Analyses (students, school districts)

Table 22- Descriptive statistics of level 2 predictors for the model with school districts as level two

Independent Variables (Level two)	N	Mean	SD	Min	Max
Community Norms	34	0.97	0.03	0.88	1
Community Activities	34	0.82	0.1	0.56	1
Rural / Non-Rural	34	0.15	0.36	0	1
White/ Non-White	34	0.68	0.28	0.06	0.98
Low SES	34	0.28	0.21	0.05	0.8
ATOD Availability	34	0.9	0.06	0.77	1
Neighborhood Safety	34	0.89	0.1	0.67	1

Table 23- Reliability and Variances for the model with school districts as level two

	Reliability	Sigma squared (σ^2)	Tau (τ)	df	Chi-square	P-value
All	0.411	0.946	0.158	33	58.558	**0.004**
Downers	0.209	0.938	0.103	33	40.536	0.172
Uppers	0.367	0.897	0.221	33	52.744	**0.016**
Others	0.411	0.919	0.206	33	58.953	**0.004**
Steroids	0.469	0.537	1.369	33	81.611	**<0.001**

Bold letters indicate statistical significance

Table 24- Measures of heterogeneity for the model with school districts as level two

	ICC	MOR	P-value
All	0.046	1.459	**0.004**
Downers	0.030	1.356	0.172
Uppers	0.063	1.563	**0.016**
Others	0.059	1.540	**0.004**
Steroids	0.294	3.039	**<0.001**

Bold letters indicate statistical significance

Table 25- Beta coefficients (SE) for the models with school districts as level two

Fixed Effect	All	Downers	Uppers	Others	Steroids
	B (SE)	B (SE)	B (SE)	B (SE)	B (SE)
Intercept	**-3.037 (0.623)**	-36.203125 5 (41140.641)	-33.707031 4 (48971.341)	**-3.013 (0.616)**	-26.509456 (81.826)
Community Norms	-2.702 (2.315)	-5.916 (6.137)	-8.924 (5.761)	-5.812 (3.388)	-10.451 (15.899)
Community Activities	-1.725 (1.306)	-1.127 (2.303)	-1.935 (1.927)	-1.050 (1.604)	6.692 (6.449)
Rural / Non-Rural	-0.146 (0.344)	0.157 (0.762)	-0.035 (0.632)	0.196 (0.602)	-10.481 (94.196)
White/ Non-White	**1.354 (0.585)**	-0.461 (1.167)	0.609 (0.942)	0.226 (0.614)	2.253 (3.064)
Low SES	0.032 (1.183)	-1.173 (1.716)	-1.825 (1.411)	-0.176 (1.439)	-0.884 (5.756)
ATOD Availability	0.671 (2.525)	0.414 (4.380)	-1.465 (3.818)	3.612 (2.635)	1.475 (11.921)
Neighborhood Safety	-0.705 (2.023)	-0.173 (3.112)	0.123 (2.403)	-0.799 (2.559)	-5.723 (8.635)
Age	0.115 (0.151)	0.277 (0.340)	0.219 (0.192)	0.312 (0.219)	1.702 (0.860)
Gender	**-0.485 (0.161)**	-0.285 (0.404)	-0.549 (0.226)	-0.520 (0.204)	-0.737 (0.938)
Race (White)	0.049 (0.245)	0.347 (0.477)	0.464 (0.267)	0.137 (0.247)	-0.468 (1.003)
Low SES	0.203 (0.275)	0.233 (0.479)	**0.568 (0.263)**	0.023 (0.238)	-0.402 (1.095)
College Plans	0.449 (0.489)	-0.057 (0.705)	0.827 (0.476)	0.607 (0.448)	10.890 (85.218)
ATOD	**1.840 (0.420)**	**2.349 (0.965)**	**3.058 (0.710)**	**1.649 (0.405)**	10.043 (48.989)
Gambling	**0.510 (0.180)**	0.582 (0.383)	**0.736 (0.210)**	**0.542 (0.244)**	0.835 (0.820)
OTC	**1.799 (0.195)**	**2.065 (0.367)**	**2.217 (0.202)**	**1.671 (0.241)**	**2.059 (0.777)**
Depression	**0.884 (0.239)**	**0.813 (0.393)**	**0.656 (0.226)**	**0.975 (0.262)**	0.421 (0.888)
Family Rules	-0.314 (0.268)	-0.172 (0.378)	**-0.516 (0.205)**	-0.229 (0.237)	1.574 (1.156)
Peer Drug Use	**-1.679 (0.578)**	30.016 (541140.641)	26.029 (448971.341)	**-2.254 (0.647)**	-1.322 (273.789)

Bold letters indicate statistical significance

Table 26- Odds Ratios (95% CI) for the model with school districts as level two

Fixed Effect	All	Downers	Uppers	Others	Steroids
	OR (95% CI)	**OR (95% CI)**	**OR (95% CI)**	**OR (95% CI)**	**OR (95% CI)**
Intercept	**0.0479 (0.013,0.173)**	-	-	**0.0492 (0.014,0.174)**	-
%Community Norms	0.067 (0.001,7.846)	0.003 (0.000,819.701)	0.0001 -	0.003 -	0.00003 -
%Community Activities	0.178 (0.012,2.615)	0.324 (0.003,37.013)	0.1445 (0.003,7.604)	0.350 (0.013,9.471)	886.961 (0.058,13533467)
Rural / Non-Rural	0.864492 (0.426,1.754)	1.170 (0.244,5.612)	0.966 (0.264,3.541)	1.216 (0.353,4.193)	0.002 (0.000,0.013)
% White students	**3.874 (1.164,12.9)**	0.631 (0.057,6.965)	1.838 (0.264,12.77)	1.254 (0.354,4.435)	9.499 (0.032,2864.109)
% Low SES	1.032 (0.091,11.78)	0.309 (0.009,10.547)	0.162 (0.009,2.938)	0.839 (0.043,16.194)	0.452612 (0.000,2412.427)
ATOD Availability	1.956 (0.011,352.7)	1.512 -	0.231 -	37.027 (0.164,8361.770)	4.900 -
Neighborhood Safety	0.494 (0.008,31.71)	0.841 (0.001,506.730)	1.131 (0.008,158.7)	0.450 (0.002,86.841)	0.004 (0.000,1425.028)
Age	1.122 (0.834,1.509)	1.319 (0.677,2.570)	1.245 (0.854,1.814)	1.367 (0.889,2.101)	5.626 (0.991,31.936)
Gender	**0.615 (0.449,0.844)**	0.752 (0.341,1.659)	**0.578 (0.371,0.899)**	**0.594 (0.399,0.886)**	0.473 (0.128,1.747)
Race (White)	1.051 (0.649,1.699)	1.415 (0.556,3.600)	1.590 (0.941,2.686)	1.146 (0.706,1.862)	0.634 (0.204,1.975)
Low SES	1.225 (0.715,2.099)	1.263 (0.494,3.230)	**1.766 (1.053,2.959)**	1.023 (0.642,1.632)	0.679 (0.145,3.192)
College Plans	1.567 (0.601,4.081)	0.945 (0.237,3.762)	2.287 (0.899,5.816)	1.835 (0.763,4.412)	1035.495 (100.888,10628)
ATOD	**6.298 (2.763,14.36)**	**10.480 (1.581,69.477)**	**21.291 (5.290,85.69)**	**5.200 (2.351,11.501)**	423.197 (190.799,939)
Gambling	**1.666 (1.170,2.370)**	1.790 (0.844,3.793)	**2.087 (1.382,3.150)**	**1.719 (1.066,2.773)**	2.378 (0.561,10.072)
OTC	**6.046 (4.126,8.858)**	**7.888 (3.844,16.187)**	**9.180 (6.176,13.65)**	**5.317 (3.316,8.524)**	**7.655 (1.403,41.764)**
Depression	**2.421 (1.514,3.871)**	**2.255 (1.044,4.872)**	**1.927 (1.238,2.998)**	**2.650 (1.587,4.426)**	1.535 (0.355,6.630)
Family Rules	0.731 (0.432,1.234)	0.842 (0.401,1.768)	**0.597 (0.400,0.891)**	0.795 (0.500,1.265)	4.830 (0.286,81.637)
Peer Drug Use	**0.187 (0.060,0.579)**	8.55E+11 -	1.55E+09 -	**0.105 (0.030,0.373)**	0.265 (0.092,0.766)

Bold letters indicate statistical significance

Table 27- Cross Level Interactions

Cross level Interactions	Adjusted OR	95% C.I	
		Lower	Upper
School Model			
Bullying x Low SES	1.784	0.016	197.004
Bullying x High SES	2.623	0.032	214.816
School Happiness x Depression	2.450	0.079	75.711
School Happiness x No Depression	0.223	0.011	4.334
School District Model			
Rural location x Low SES	0.425	0.029	6.288
Non-Rural location x Low SES	1.170	0.724	1.892
Rural location x High SES	0.876	0.074	10.351
ATOD Availability x Female	15.633	0.029	8936.083
ATOD Availability x Male	0.137	<0.001	44.960

Table 28- Socio Ecological Level Two Estimates

Level two predictors	Variance	Standard Error
Community norms	**0.113482**	**0.114951**
ATOD availability	**0.129833**	**0.129947**
Community activities	1.13E-14	8.56E-08
Community safety	1.10E-11	5.23E-06
Location	1.13E-21	4.58E-11
Bullying	**1.331263**	**3.381933**
Teacher care	9.53E-14	4.20E-07
School happiness	9.94E-08	0.000902
Race (White)	1.07E-16	7.64E-09
Low SES	**0.669827**	**0.749817**

Model Fit

Table 29- Model Fit Measures (for models without interactions)

	Null Model	Model 1	Model 2
AIC with correction (AICC)	7,940.49	**7396.229**	8393.914
Bayesian Information Criterion (BIC)	7,951.17	**7406.684**	8430.456
Accuracy	88.60%	89.90%	90.10%
-2LL	7936.478	7392.22	8379.832

Table 30 -Model Fit Measures (for models with interactions)

	Null Model	Model 1	Model 2	Model 3
Akaike Information Criterion (AIC)	1096.923	**711.501**	717.260	720.097
Bayesian Information Criterion (BIC)	1107.615	**778.822**	800.117	813.3112
Observations	1550	1311	1311	1311
LL(model)	-546.461	-342.751	-342.63	-342.049
df	2	13	16	18

Missing Data Analysis

Table 31- Missing data for dependent variables

Variable	N	Missing	
		Count	Percent
Prescription Drug Abuse	1550	0	0
Downers Abuse	1550	0	0
Other Prescription Drug Abuse	1550	0	0
Steroid Abuse	1550	0	0
Uppers Abuse	1550	0	0

Table 32- Missing data for level one predictors

Variable	N	Missing	
		Count	Percent
Age	1550	0	0
Gender	1541	9	0.6
Race (White)	1542	8	0.5
Low SES	1542	8	0.5
College Plans	1385	165	10.6
ATOD	1532	18	1.2
OTC	1550	0	0
Depression	1507	43	2.8
Gambling	1514	36	2.3
Family Rules	1475	75	4.8
Peer Drug Use	1550	0	0

Table 33- Missing data for level two predictors

Variable	N	Missing		No. of Extremes	
		Count	Percent	Low	High
% Bullying	1550	0	0	109	84
% Caring Teacher/Adult	1550	0	0	36	0
% Happy with school	1550	0	0	0	0
% Minority	1550	0	0	0	0
% Low SES	1550	0	0	0	54
Perceived Community Norms	1550	0	0	86	0
Participation in Community Activities	1550	0	0	20	0
Rural / Non-Rural	1550	0	0	0	0
ATOD Availability	1550	0	0	0	0
Safe Community	1550	0	0	0	0

Multicollinearity

Table 34 –Collinearity Statistics

Predictors	Tolerance	VIF
Student level		
Age	0.964	1.037
Gender	0.857	1.166
Race (White)	0.546	1.831
Low SES	0.595	1.68
College Plans	0.95	1.053
ATOD	0.894	1.118
OTC	0.942	1.061
Depression	0.94	1.064
Gambling	0.854	1.171
Family Rules	0.958	1.044
Peer Drug Use	0.919	1.088
School level		
White Student %	0.480	2.082
Low SES	0.608	1.645
Bullying	0.779	1.284
Teacher/Adult care	0.519	1.927
School Happiness	0.398	2.515
Rural location	0.703	1.422
School district level		
White Student %	0.543	1.843
Low SES	0.517	1.934
Community Norms	0.689	1.451
Community Activities	0.73	1.37
ATOD Availability	0.871	1.148
Community Safety	0.859	1.165
Rural location	0.717	1.394

Table 35 –Correlation matrix of school level predictors

Predictors	% Bullying	% Caring Teacher/ Adult	% Happy with school	% Minority	% Low SES
% Bullying	1				
% Caring Teacher/Adult	.067**	1			
% Happy with school	-.286**	.563**	1		
% Minority	.085**	.388**	.458**	1	
% Low SES	0.034	-.336**	-.578**	-.769**	1

** Correlation is significant at the 0.01 level (2-tailed).

Table 36 –Correlation matrix of school district predictors

Predictors	Perceived Community Norms towards ATOD	Participation in Community Activities	Rural / Non-Rural	ATOD Availability	Safe Community
Perceived Community Norms towards ATOD	1				
Participation in Community Activities	0.029	1			
Rural / Non-Rural	.256**	.109**	1		
ATOD Availability	.241**	-.125**	-.146**	1	
Safe Community	.356**	.360**	.085**	.515**	1

** Correlation is significant at the 0.01 level (2-tailed).

Analyses on data aggregated to school and school district levels

Table 37- Prescription Drug Abuse by Level Two Units

	Schools			School Districts		
	Chi-Square	df	p-value	Chi-Square	df	p-value
Prescription Drug Abuse	61.295	41	**0.022**	57.893	33	**0.005**
Downers Abuse	42.542	41	0.405	38.628	33	0.23
Other Drug Abuse	61.968	41	**0.019**	55.863	33	**0.008**
Steroid Abuse	57.334	41	**0.047**	51.236	33	**0.022**
Uppers Abuse	52.837	41	0.102	49.701	33	**0.031**

Bold letters indicate statistical significance

Table 38- Correlations of School level predictors and prescription drug abuse

Predictor	Pearson Correlation (r)	p-value
White Student %	**0.253**	**0.053**
Low SES	**-0.209**	**0.092**
Bullying	**0.212**	**0.089**
Teacher/Adult care	-0.081	0.304
School Happiness	-0.126	0.213
Rural location	-0.122	0.221

Bold letters indicate statistical significance

Table 39- Correlations of School district level predictors and prescription drug abuse

Predictor	Pearson Correlation (r)	p-value
White Student %	0.051	0.387
Low SES	-0.055	0.379
Community Norms	0.075	0.336
Community Activities	-0.178	0.156
ATOD Availability	**-0.356**	**0.019**
Community Safety	**0.401**	**0.009**
Rural location	-0.125	0.241

Bold letters indicate statistical significance

Table 40- Multiple regression - school level predictors

	Unstandardized Coefficients		Standardized Coefficients			95% CI for B	
Predictor	B	SE	Beta	t	p-value	LL	UL
(Constant)	9.791	13.316		0.735	0.467	-17.242	36.825
White Student %	0.076	0.039	0.411	1.974	0.056	-0.002	0.155
Low SES	-0.049	0.043	-0.21	-1.132	0.265	-0.135	0.038
Bullying	0.115	0.129	0.147	0.897	0.376	-0.146	0.377
Teacher/Adult care	0.062	0.177	0.071	0.353	0.726	-0.296	0.421
School Happiness	-0.177	0.093	-0.434	-1.895	0.066	-0.367	0.013
Rural location	**-6.427**	**3.199**	**-0.346**	**-2.009**	**0.052**	**-12.921**	**0.068**

Bold letters indicate statistical significance

Table 41- Multiple regression - school district level predictors

Predictor	Unstandardized Coefficients		Standardized Coefficients	t	p-value	95% CI for B	
	B	SE	Beta			LL	UL
(Constant)	16.568	8.885		1.865	0.074	-1.694	34.831
White Student %	0.006	0.042	0.033	0.153	0.879	-0.08	0.093
Low SES	-0.027	0.07	-0.084	-0.384	0.704	-0.171	0.117
Community Norms	-0.001	0.026	-0.007	-0.038	0.97	-0.053	0.052
Community Activities	-0.059	0.071	-0.153	-0.834	0.412	-0.205	0.087
ATOD Availability	**-0.078**	**0.037**	**-0.352**	**-2.096**	**0.046**	**-0.154**	**-0.002**
Community Safety	**0.087**	**0.034**	**0.435**	**2.575**	**0.016**	**0.018**	**0.157**
Rural location	-4.337	3.357	-0.239	-1.292	0.208	-11.236	2.563

Bold letters indicate statistical significance

Table 42- Binary Logistic Regression

Predictors	B	SE	Adjusted OR	95% C.I		P-value
				Lower	Upper	
Age	0.1	0.189	1.105	0.763	1.602	0.597
Gender	**0.476**	**0.229**	**1.61**	**1.028**	**2.522**	**0.038**
Race (White)	-0.097	0.28	0.908	0.524	1.573	0.731
Low SES	-0.186	0.282	0.83	0.478	1.443	0.509
College Plans	-0.428	0.439	0.652	0.276	1.543	0.331
ATOD	**-1.83**	**0.393**	**0.16**	**0.074**	**0.347**	**<0.001**
OTC	**-1.831**	**0.209**	**0.16**	**0.106**	**0.242**	**<0.001**
Depression	**-0.883**	**0.232**	**0.414**	**0.262**	**0.652**	**<0.001**
Gambling	**-0.528**	**0.219**	**0.59**	**0.384**	**0.907**	**0.016**
Family Rules	0.295	0.22	1.343	0.873	2.067	0.179
Peer Drug Use	1.742	1.146	5.711	0.605	53.922	0.128
% Bullying	1.78	1.43	5.929	0.36	97.777	0.213
% Caring Teacher/Adult	3.546	2.497	34.677	0.26	4630.928	0.156
% Happy with school	-1.493	1.241	0.225	0.02	2.558	0.229
% Minority	1.09	0.694	2.974	0.764	11.578	0.116
% Low SES	0.134	0.899	1.144	0.196	6.657	0.881
Community Norms	-2.052	3.596	0.129	0	147.857	0.568
Community Activities	**-2.632**	**1.483**	**0.072**	**0.004**	**1.315**	**0.076**
Rural / Non-Rural	-0.628	0.53	0.534	0.189	1.507	0.236
ATOD Availability	-0.517	2.663	0.596	0.003	110.139	0.846
Safe Community	1.348	1.681	3.848	0.143	103.874	0.423
Constant	-1.577	5.674	0.207			0.781

Bold letters indicate statistical significance

Table 43- Model comparison

	Binary Logistic Regression	**Multilevel Logistic Regression**		
		HLM	**STATA**	**SPSS**
	OR (95% CI)	**OR (95% CI)**	**OR (95% CI)**	**OR (95% CI)**
Age	1.081 (0.75,1.56)	1.122 (0.834,1.509)	1.127 (0.772,1.645)	1.146 (0.839,1.566)
Gender	**0.586 (0.377,0.911)**	**0.615 (0.449,0.844)**	**0.594 (0.380,0.928)**	**0.604 (0.432,0.844)**
Race (White)	1.418 (0.889,2.262)	1.051 (0.649,1.699)	1.319 (0.805,2.160)	1.272 (0.809,1.999)
Low SES	1.094 (0.667,1.794)	1.225 (0.715,2.099)	1.149 (0.687,1.923)	1.195 (0.664,2.149)
College Plans	1.376 (0.586,3.229)	1.567 (0.601,4.081)	1.433 (0.603,3.404)	1.459 (0.561,3.796)
ATOD	**6.298 (2.945,13.468)**	**6.298 (2.763,14.36)**	**6.345 (2.949,13.654)**	**6.341 (2.632,15.28)**
Gambling	**1.63 (1.07,2.483)**	**1.666 (1.170,2.370)**	**1.628 (1.063,2.496)**	**1.612 (1.108,2.347)**
OTC	**6.06 (4.062,9.04)**	**6.046 (4.126,8.858)**	**6.177 (4.101,9.303)**	**6.077 (4.088,9.033)**
Depression	**2.465 (1.58,3.847)**	**2.421 (1.514,3.871)**	**2.434 (1.550,3.821)**	**2.404 (1.471,3.928)**
Family Rules	0.753 (0.493,1.15)	0.731 (0.432,1.234)	0.743 (0.483,1.142)	0.751 (0.446,1.265)
Peer Drug Use	0.237 (0.025,2.221)	**0.187 (0.060,0.579)**	0.210 (0.022,1.989)	-

Bold letters indicate statistical significance

Table 44- Crude vs. Adjusted Odds Ratios

Level-1 Predictors	Crude OR (95% CI)	Adjusted OR (95% CI) School Model	Adjusted OR (95% CI) School District Model
Age	1.025 (0.775,1.355)	1.120 (0.755,1.661)	1.122 (0.834,1.509)
Gender	**1.69 (1.229,2.323)**	**0.621 (0.386,0.998)**	**0.615 (0.449,0.844)**
Race	0.942 (0.672,1.321)	1.091 (0.609,1.955)	1.051 (0.649,1.699)
Low SES	0.79 (0.561,1.114)	1.199 (0.668,2.153)	1.225 (0.715,2.099)
College Plans	1.361 (0.673,2.754)	1.488 (0.595,3.721)	1.567 (0.601,4.081)
ATOD use	**8.735 (4.567,16.708)**	**6.095 (2.708,13.717)**	**6.298 (2.763,14.36)**
Gambling	**2.2 (1.589,3.047)**	**1.684 (1.069,2.655)**	**1.666 (1.170,2.370)**
OTC drug use	**8.164 (5.842,11.41)**	**6.081 (3.952,9.358)**	**6.046 (4.126,8.858)**
Depression	**2.235 (1.585,3.151)**	**2.381 (1.475,3.844)**	**2.421 (1.514,3.871)**
Family rules	**1.93 (1.376,2.707)**	0.730 (0.463,1.151)	0.731 (0.432,1.234)
Peer Drug Use (past month)	2.862 (0.383,21.362)	0.192 (0.018,2.075)	**0.187 (0.060,0.579)**

Bold letters indicate statistical significance

FIGURES

Descriptive Statistics

Prevalence and Trends

Figure 1- 2009 Illinois 12th Graders' Prescription Drug Abuse Prevalence

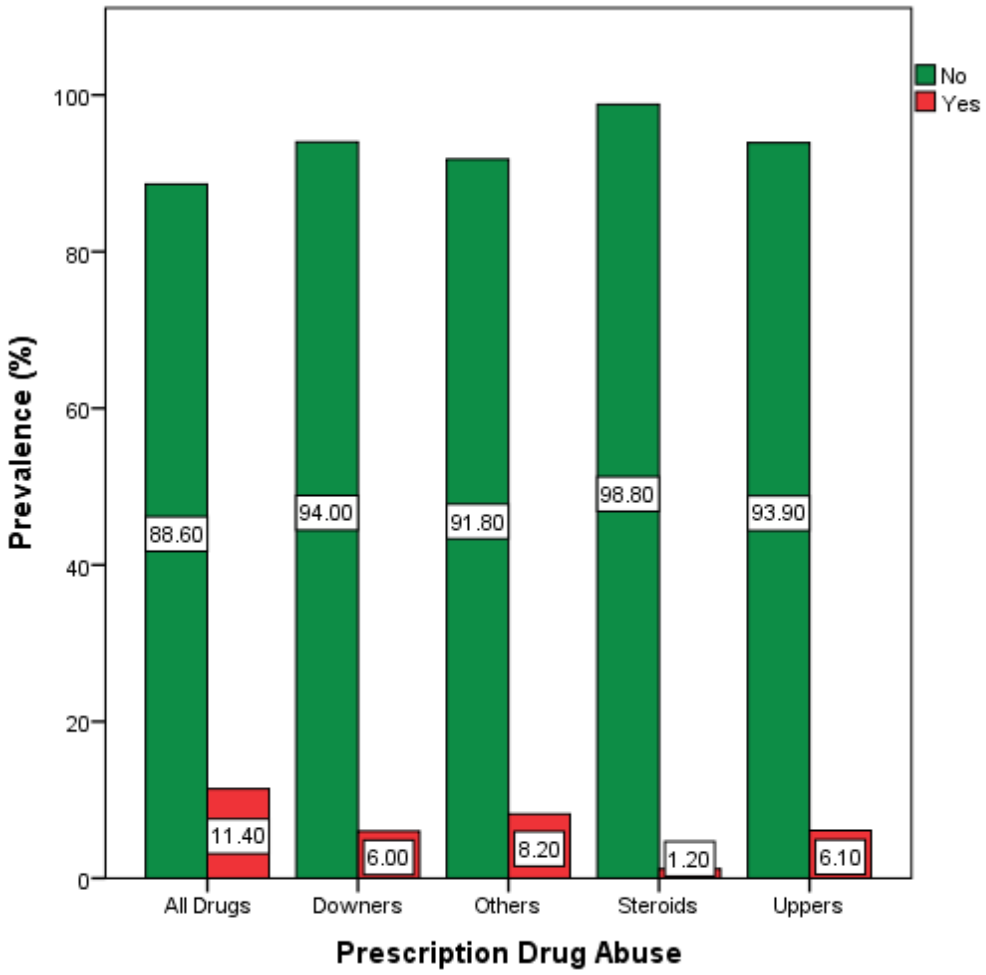


Figure 2- Prescription drug abuse trends among Illinois 12th graders, 2004-2010

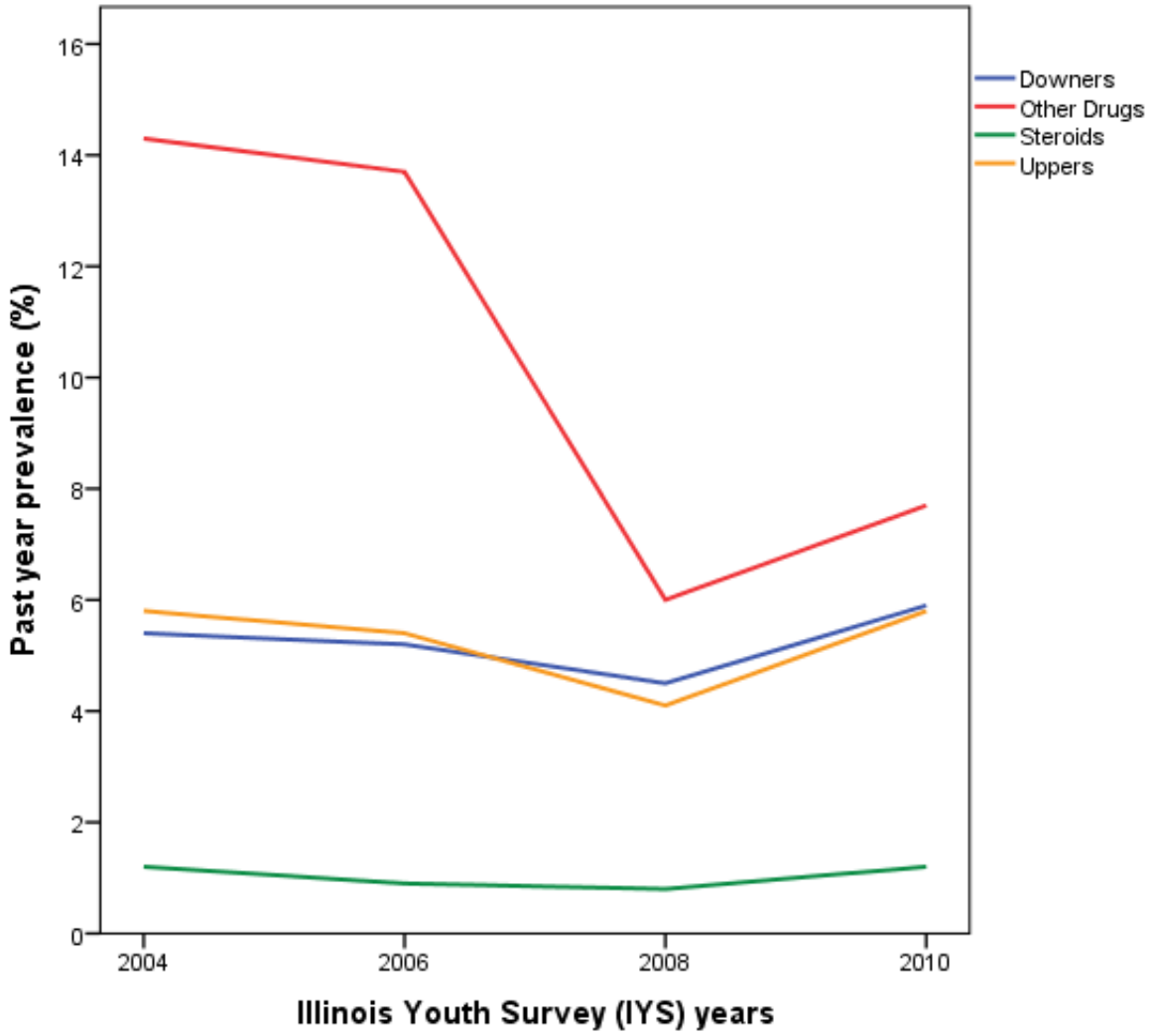
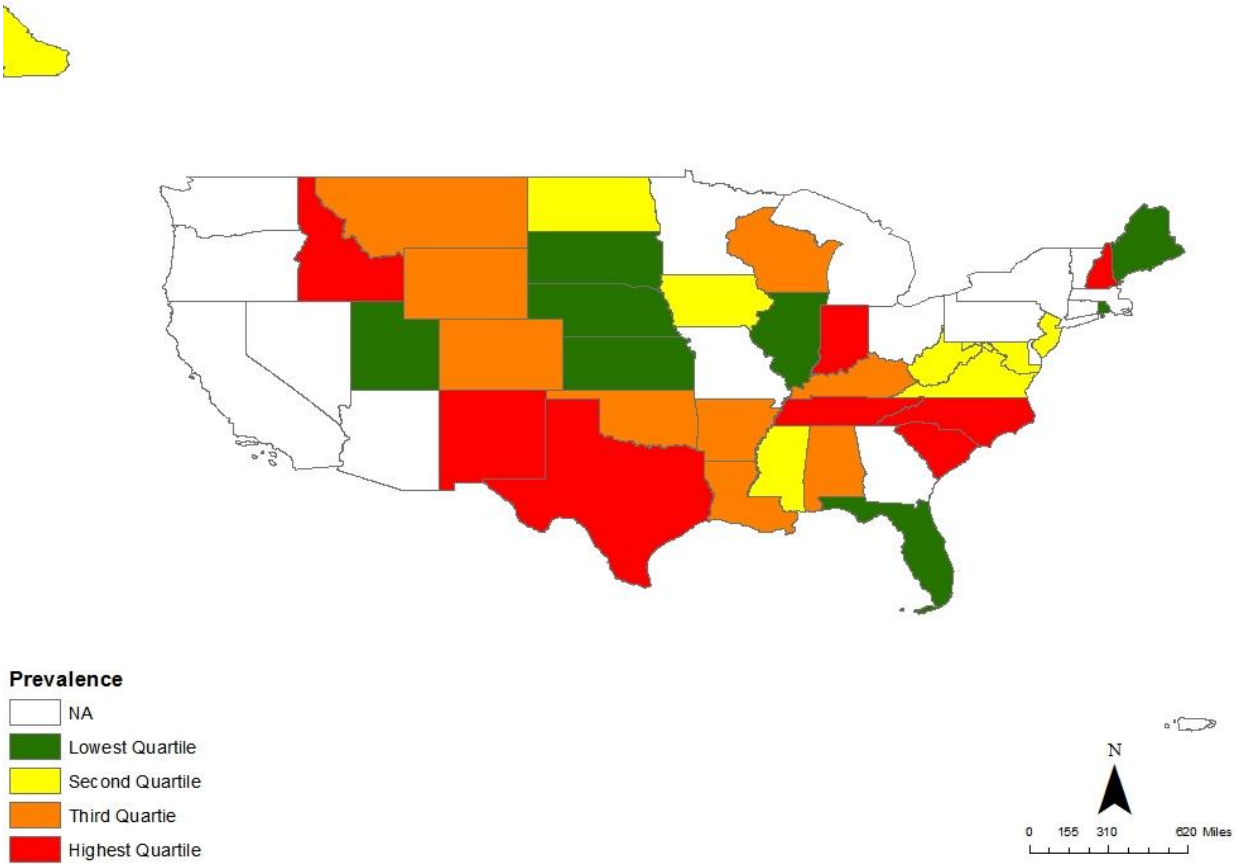


Figure 3- 12th Graders' Prescription Drug Abuse- 2011 Lifetime Prevalence by State



Data Source: 2011 Youth Risk Behavior Surveillance System (YRBSS)

Prescription Drug Abuse by Illinois Schools

Figure 4- - Prescription drug abuse prevalence by Illinois schools

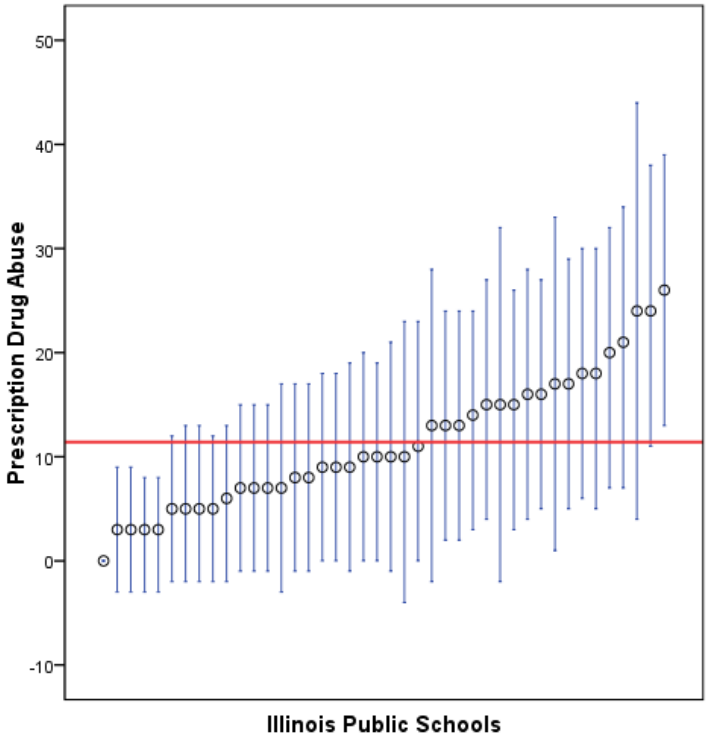


Figure 5- - Downers abuse prevalence by Illinois schools

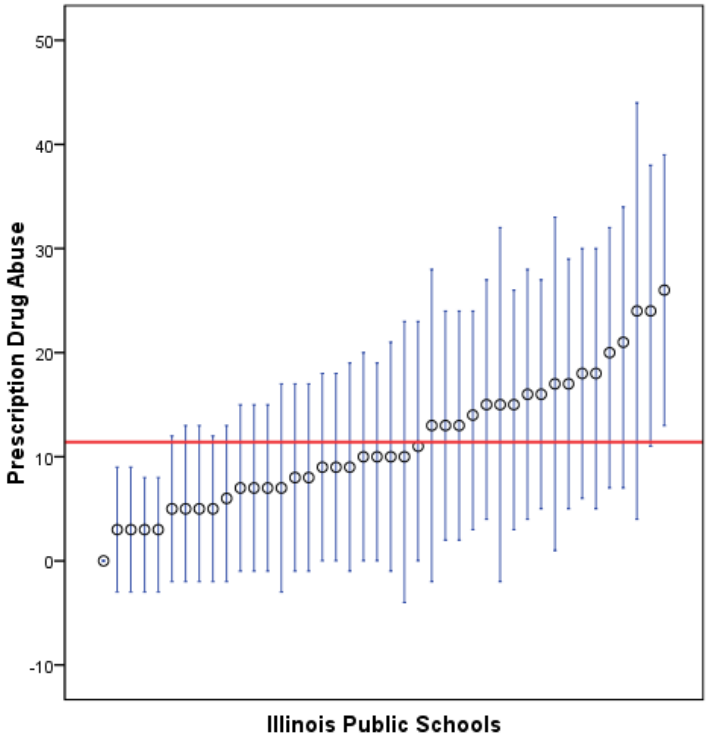


Figure 6- Uppers abuse prevalence by Illinois schools

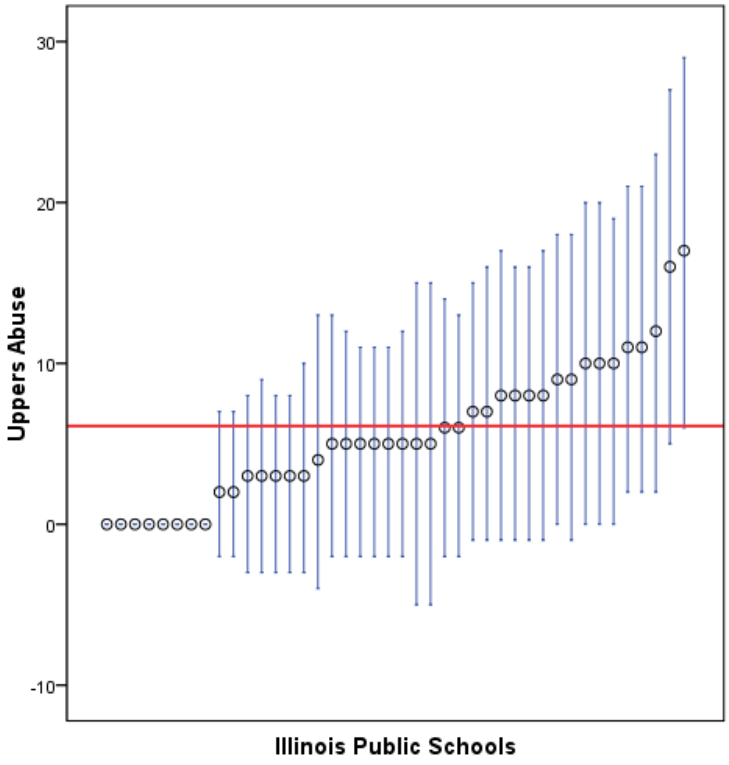


Figure 7- Other drug abuse prevalence by Illinois schools

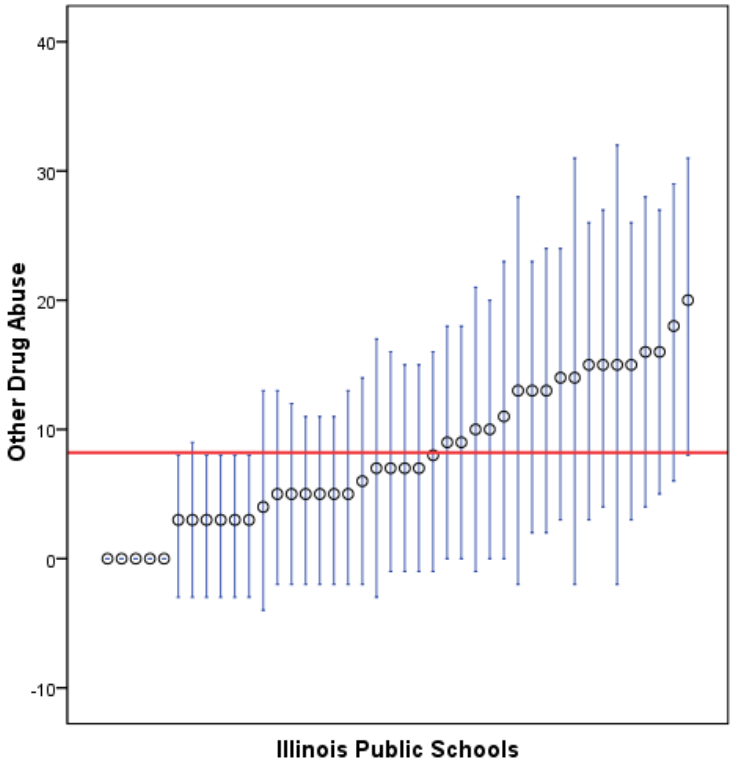
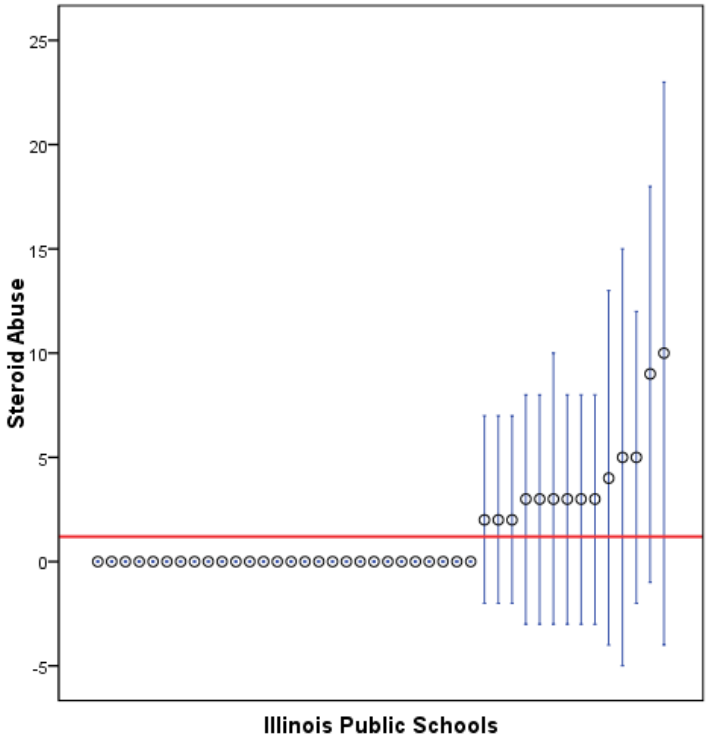


Figure 8- Steroid abuse prevalence by Illinois schools



Prescription Drug Abuse by Level One Predictors

Figure 9-Age distribution of the sample

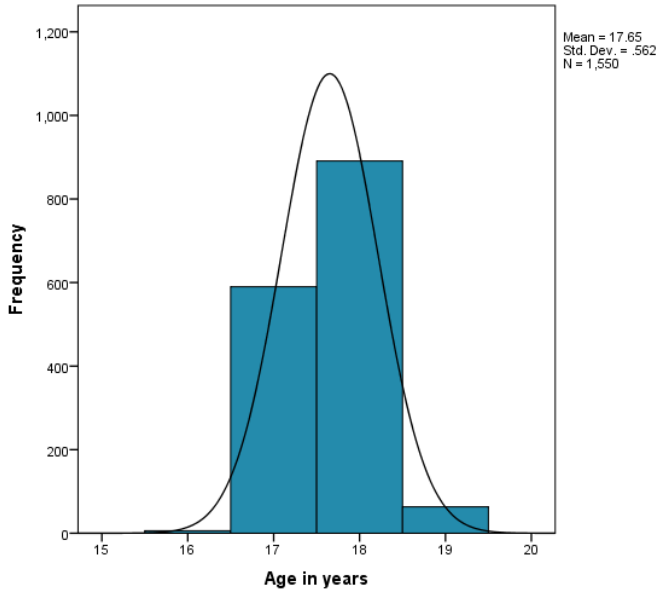


Figure 10-Age distribution by prescription drug abuse status

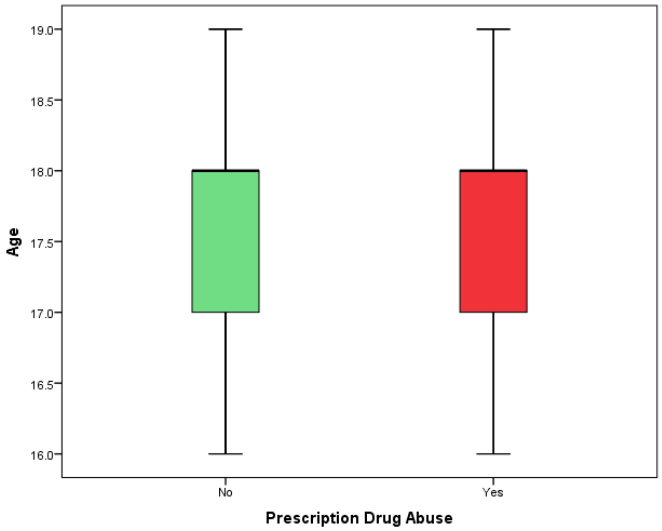


Figure 11- Prescription Drug Abuse by Gender

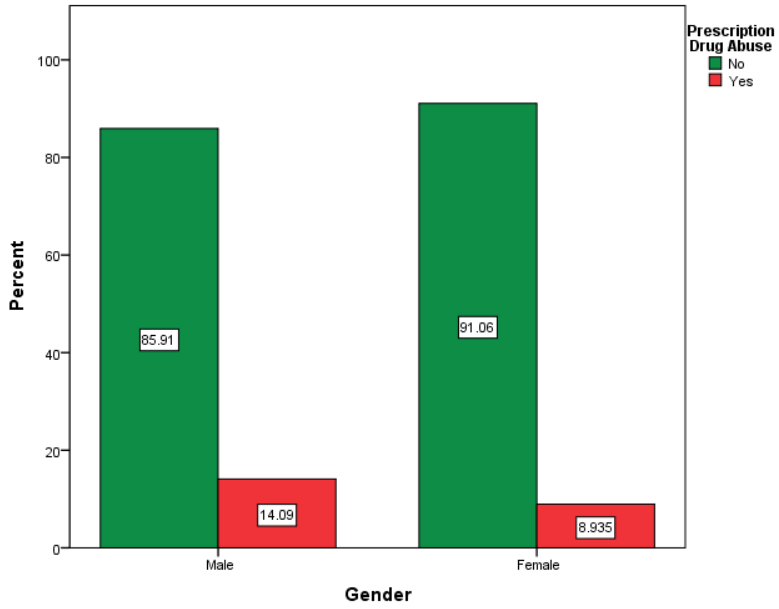


Figure 12- Prescription Drug Abuse by Race

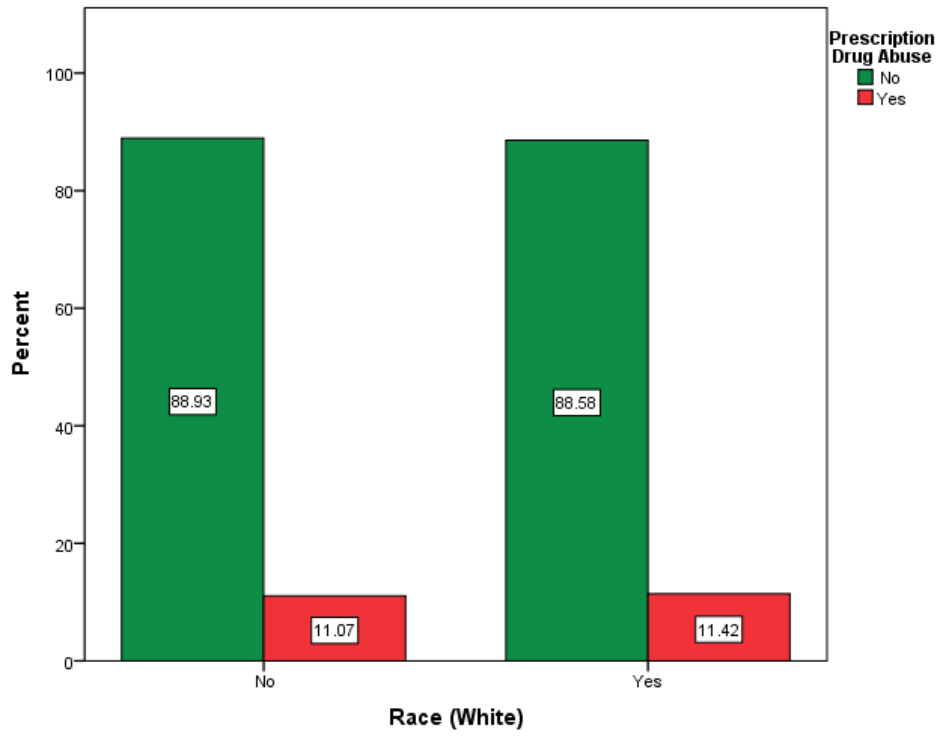


Figure 13- Prescription Drug Abuse by SES

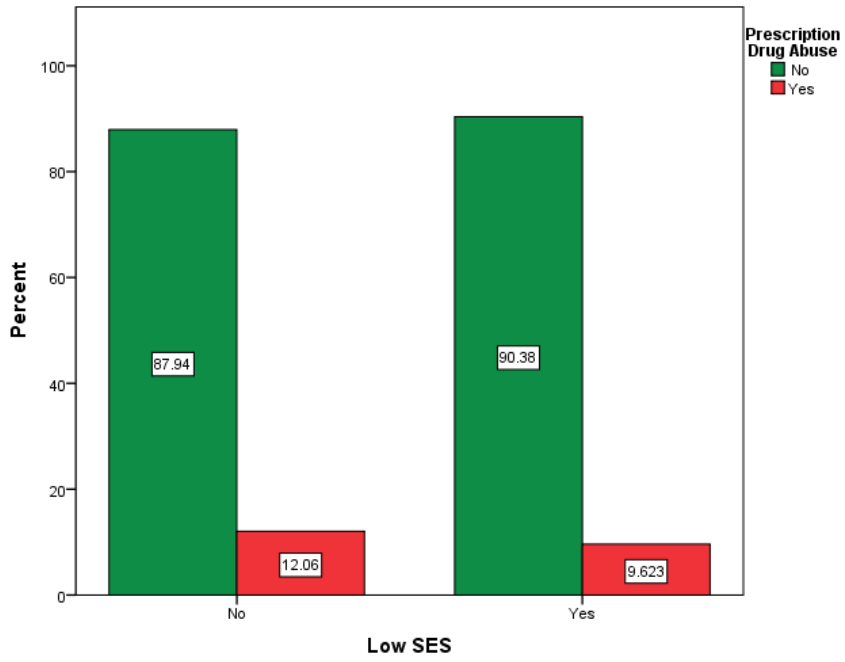


Figure 14- Prescription Drug Abuse by College Plans

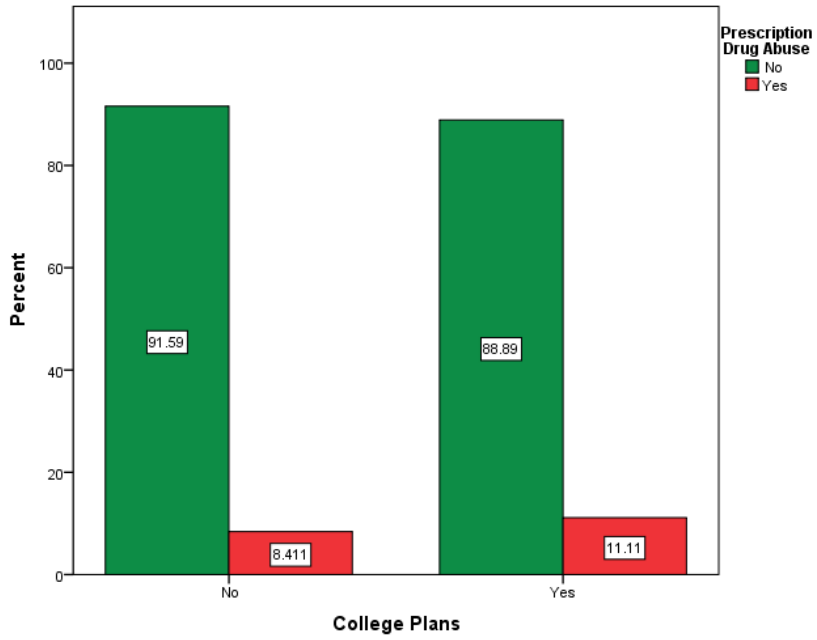


Figure 15- Prescription Drug Abuse by ATOD use (past year)

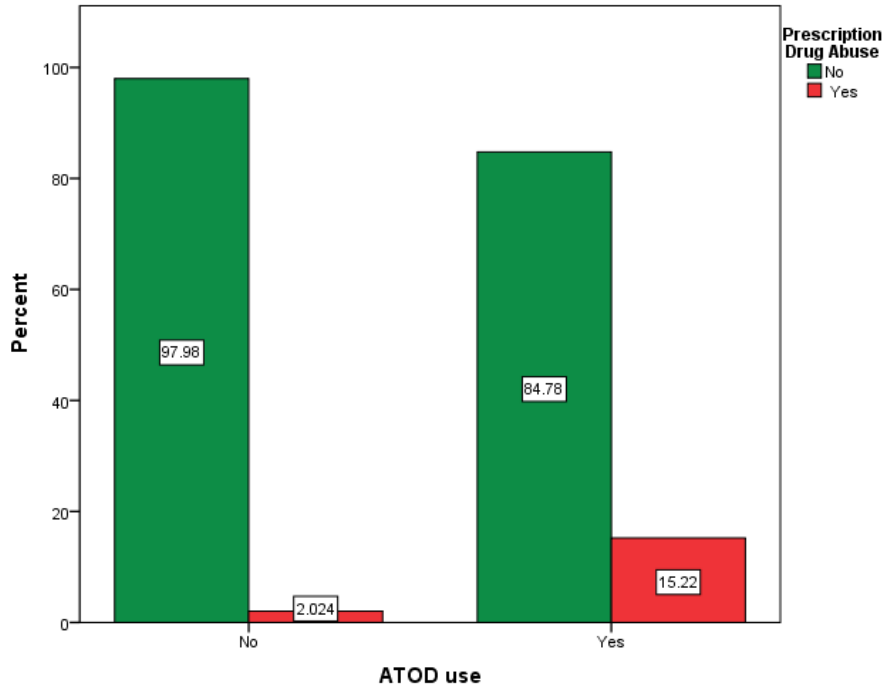


Figure 16- Prescription Drug Abuse by OTC use (past year)

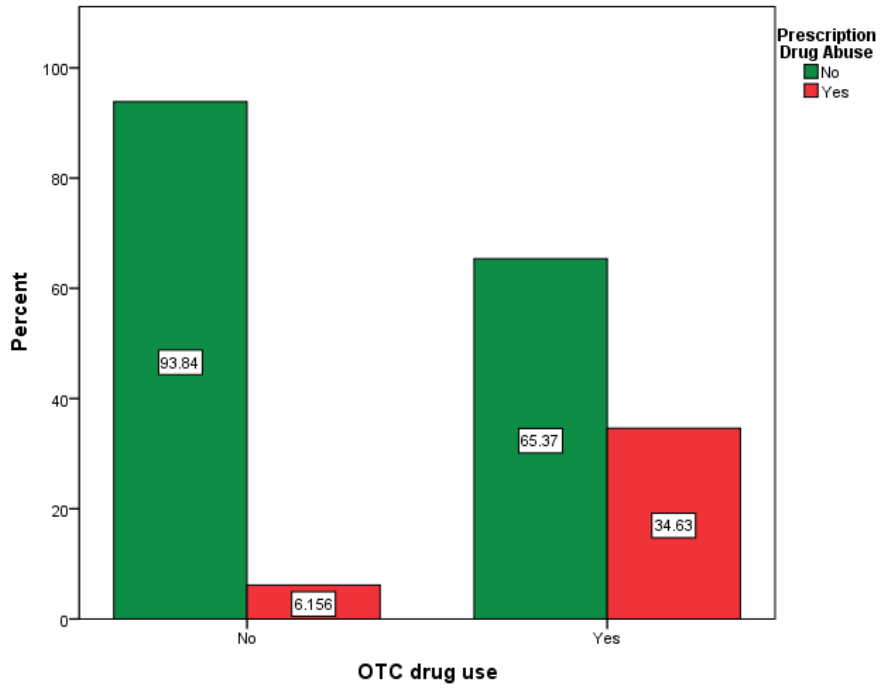


Figure 17- Prescription Drug Abuse by Depression (past year)

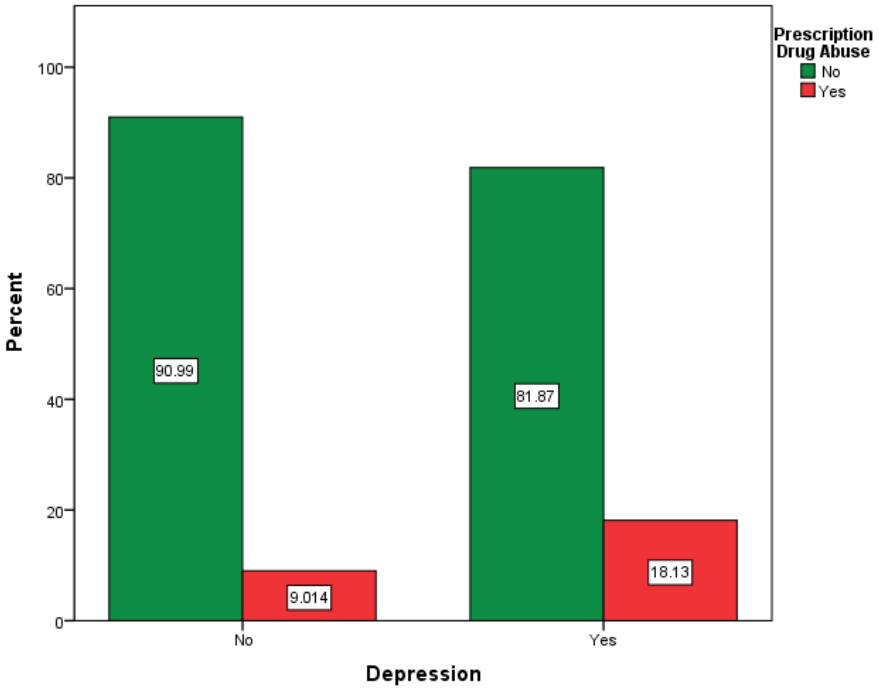


Figure 18- Prescription Drug Abuse by Gambling (past year)

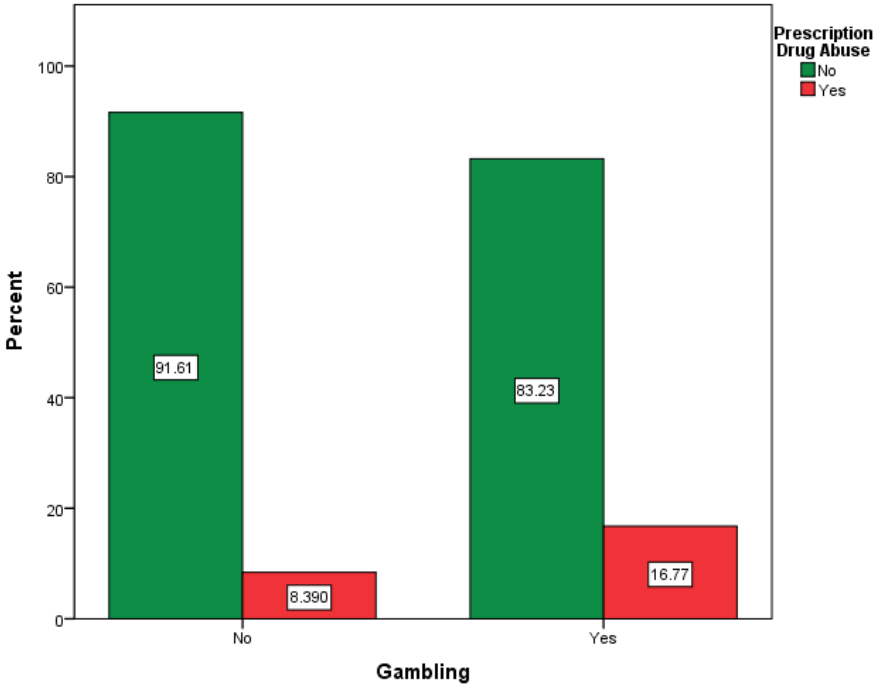


Figure 19- Prescription Drug Abuse by Family ATOD Rules

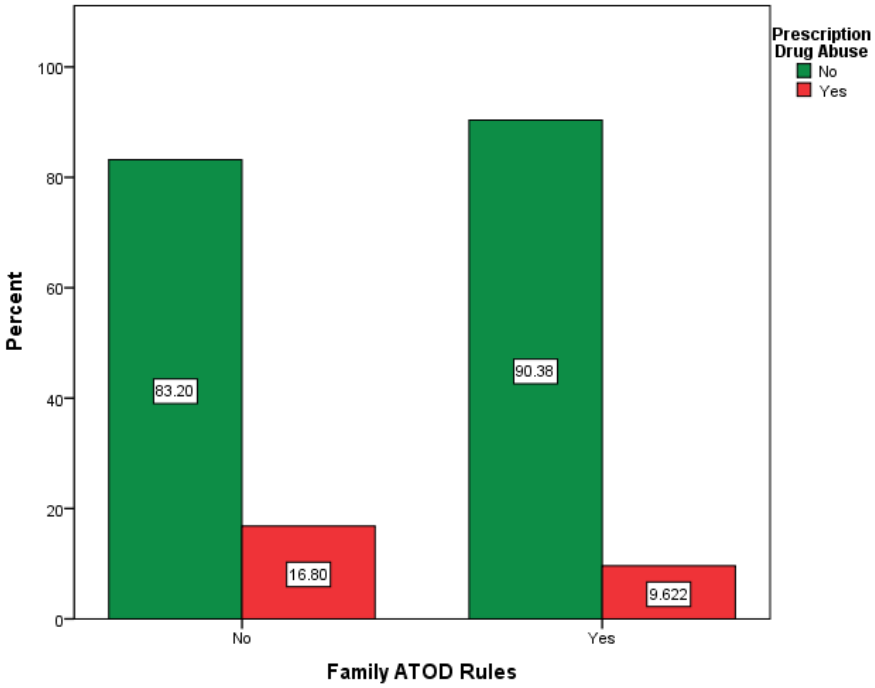
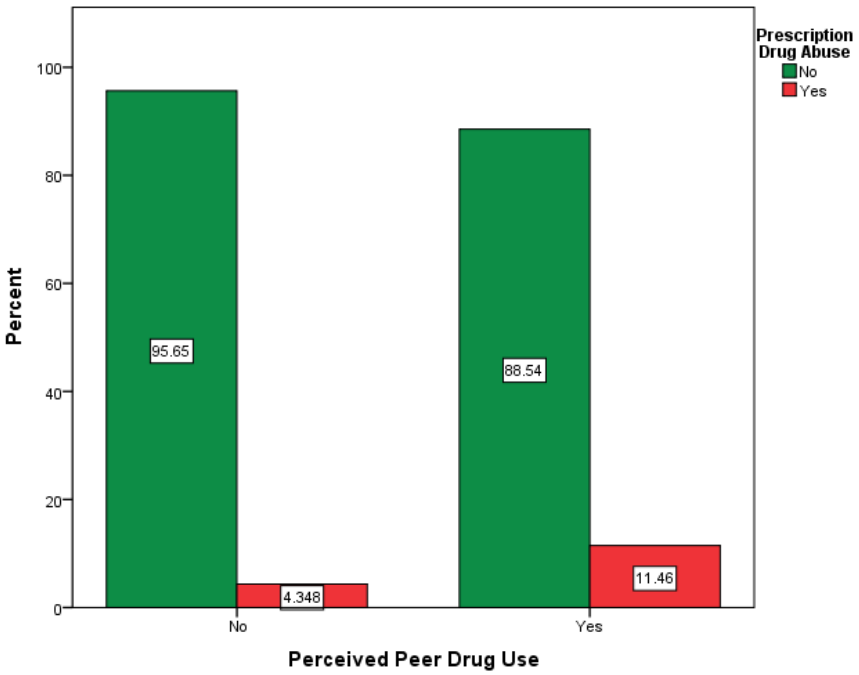


Figure 20- Prescription Drug Abuse by Peer Drug Use (past month)



HGLM Model Graphs

Figure 21- Prescription Drug Abuse by Age

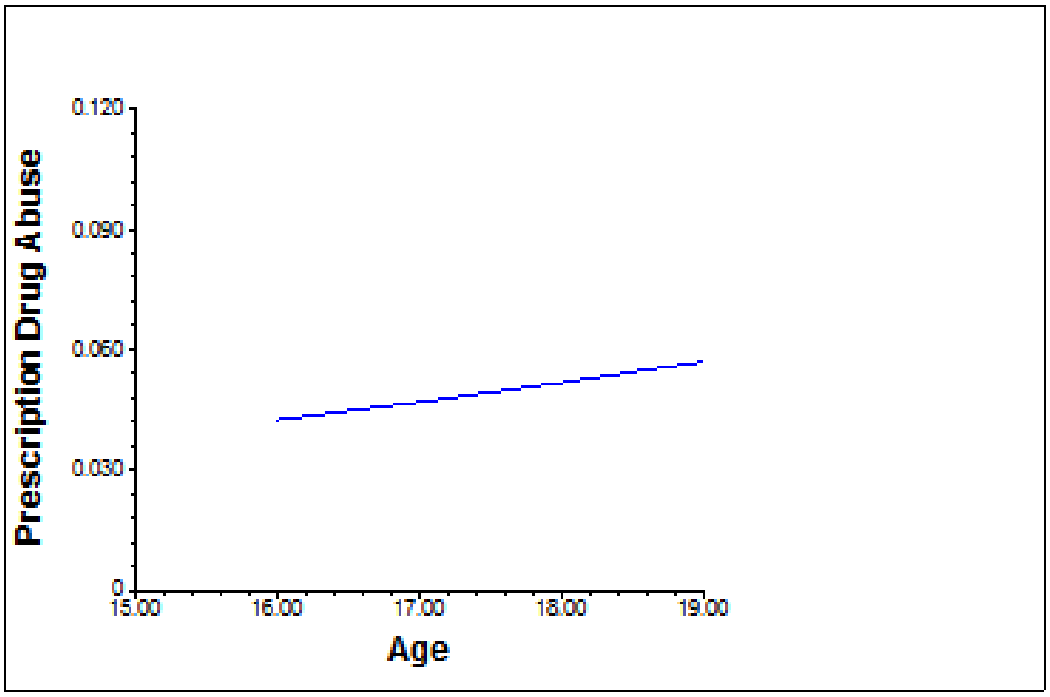


Figure 22- Prescription Drug Abuse by Race (White Students %) (school level)

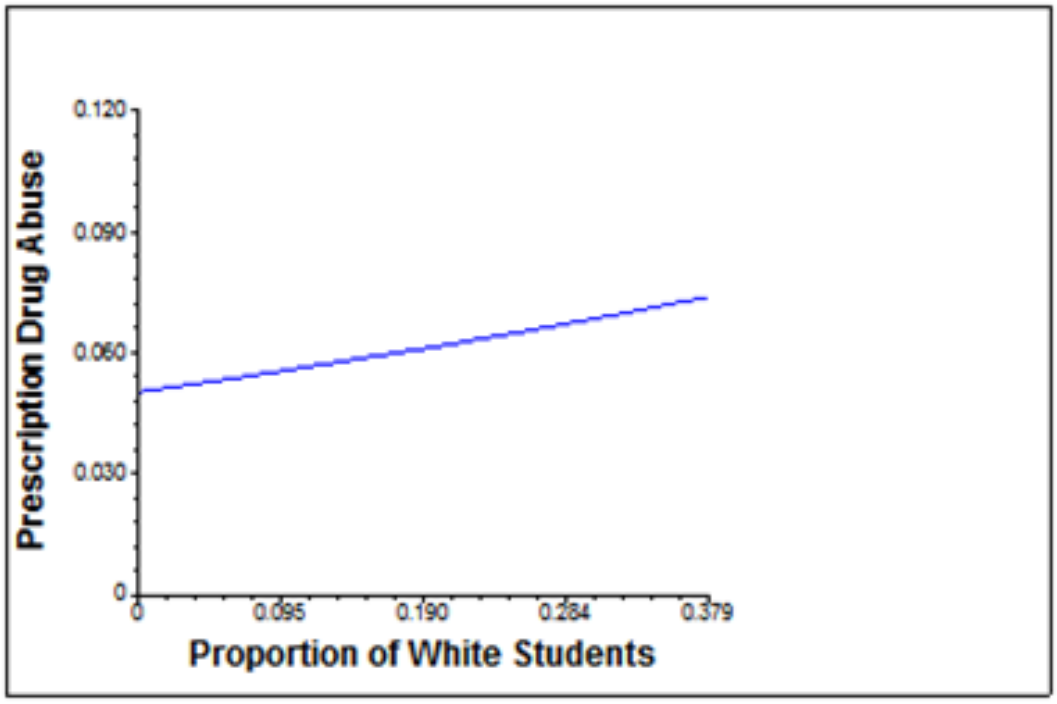


Figure 23- Prescription Drug Abuse by SES (school level)

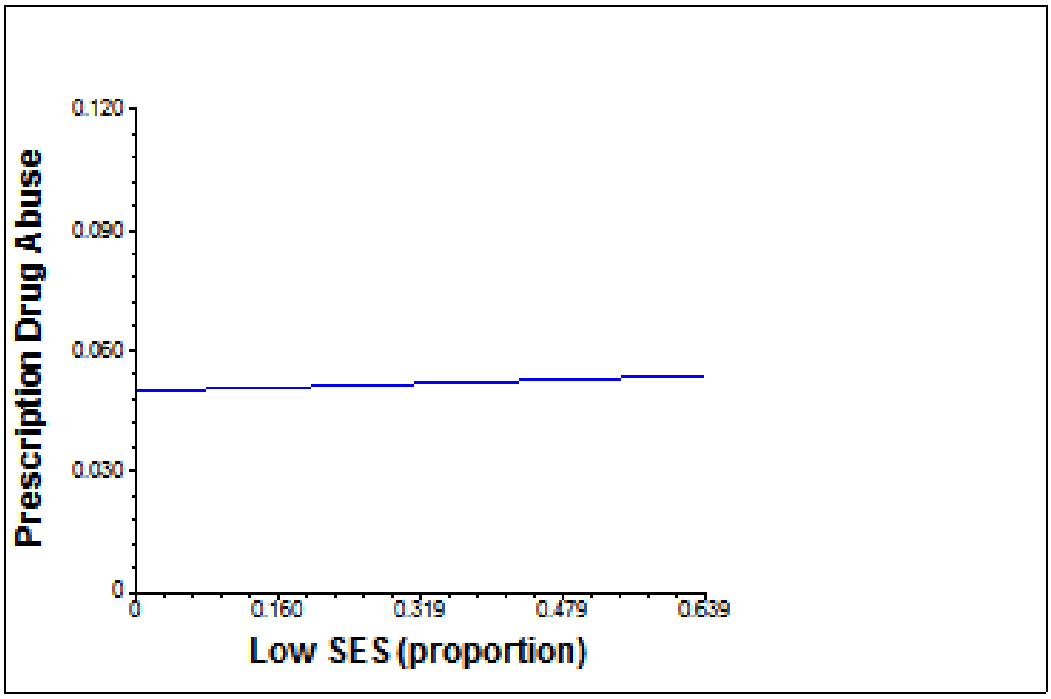


Figure 24- Prescription Drug Abuse by Bullying (school level)

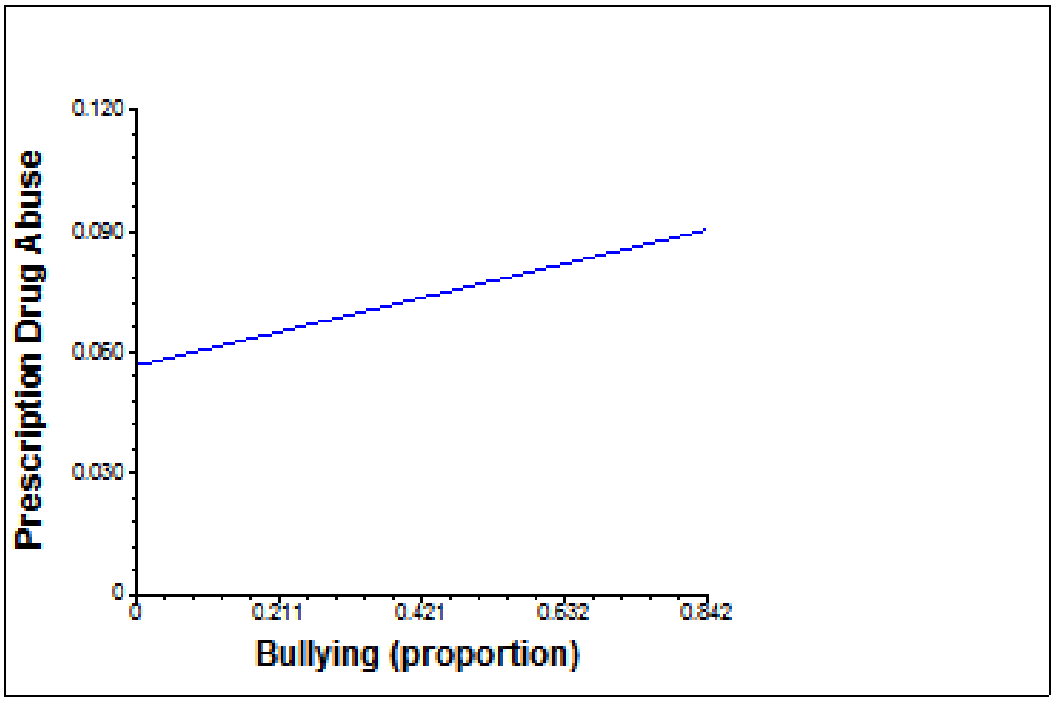


Figure 25- Prescription Drug Abuse by Teacher/Adult Care (school level)

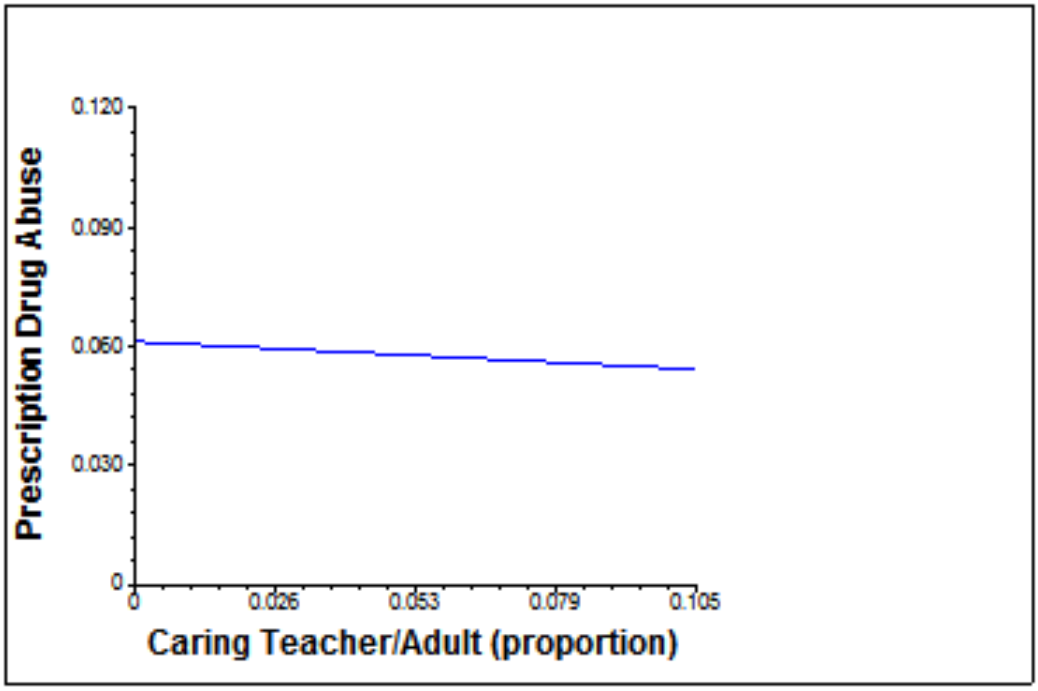


Figure 26- Prescription Drug Abuse by School Happiness (school level)

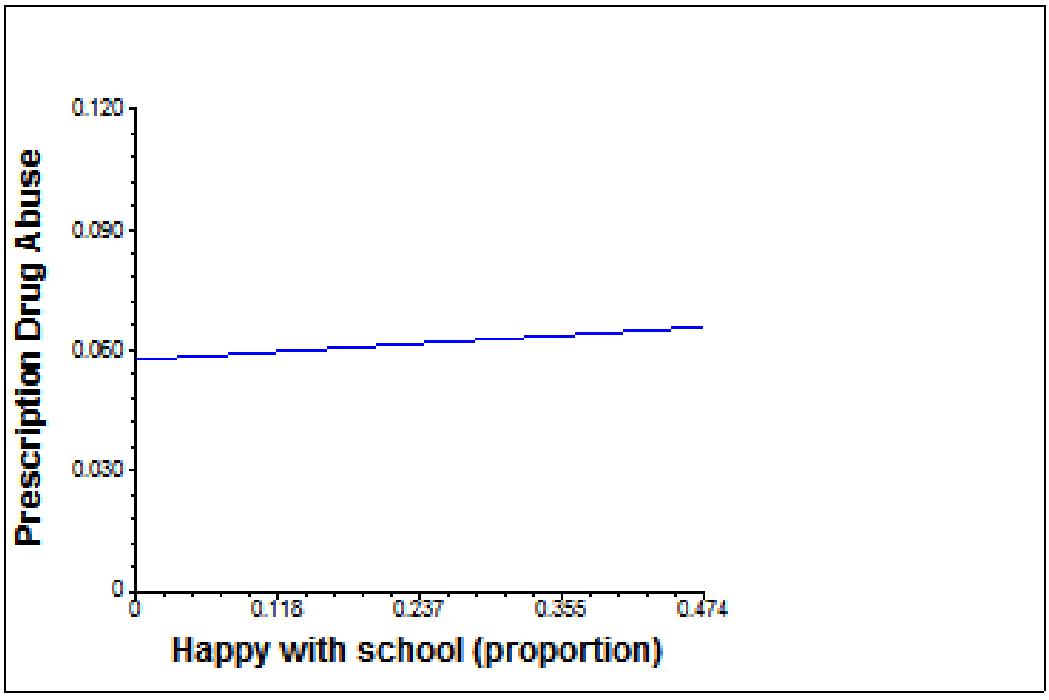


Figure 27- Prescription Drug Abuse by ATOD Community Norms (school district level)

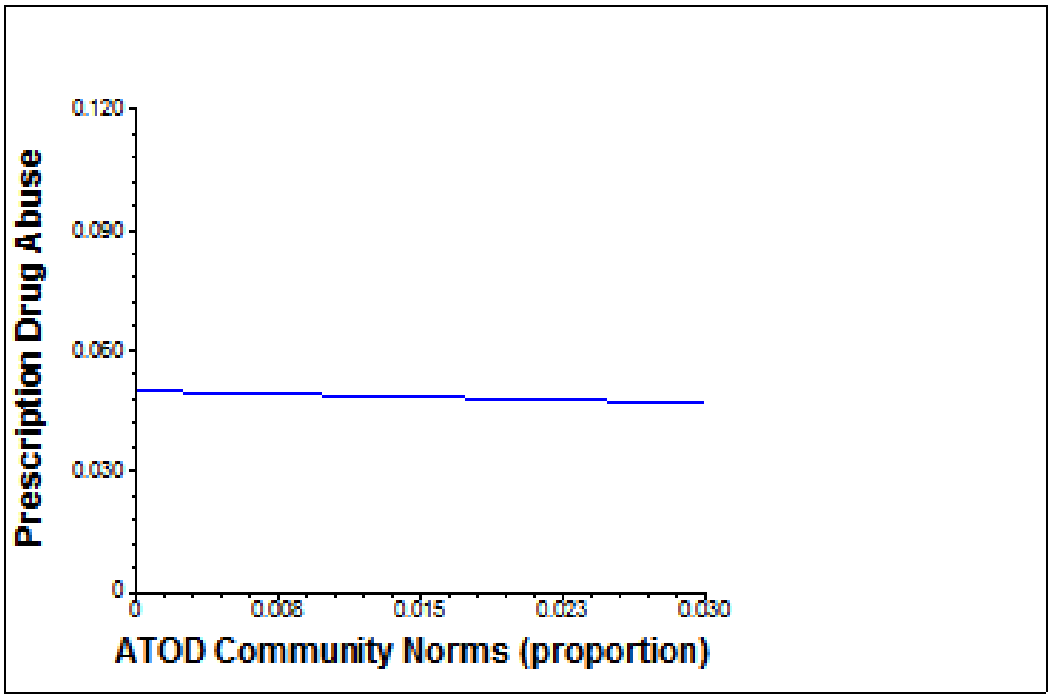


Figure 28- Prescription Drug Abuse by Community Activities (school district level)

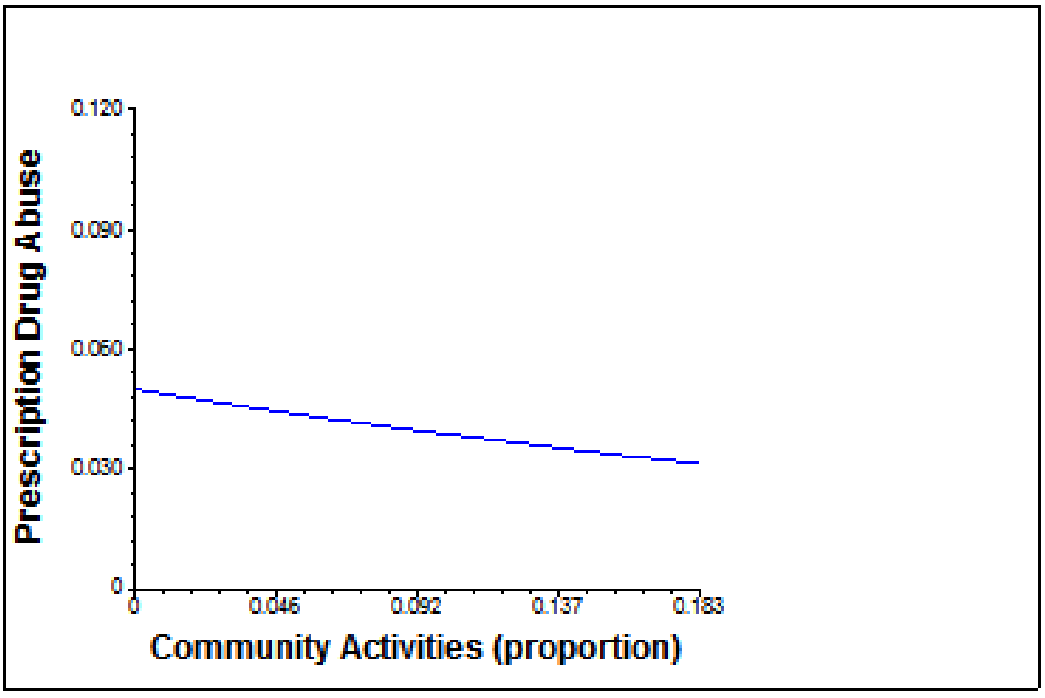


Figure 29- Prescription Drug Abuse by ATOD Availability (school district level)

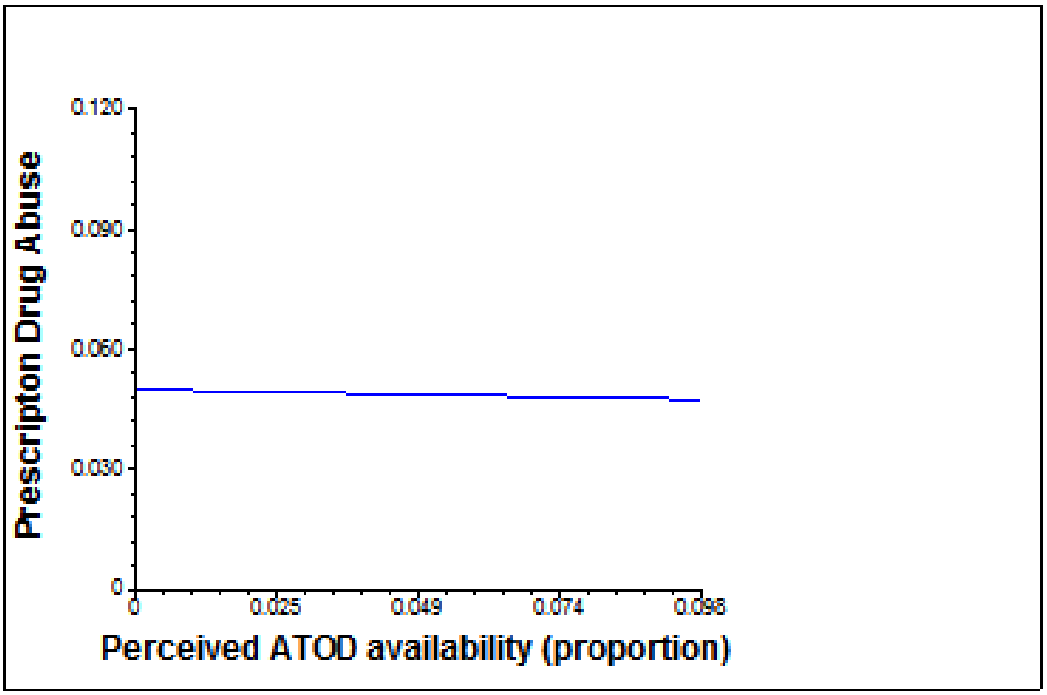
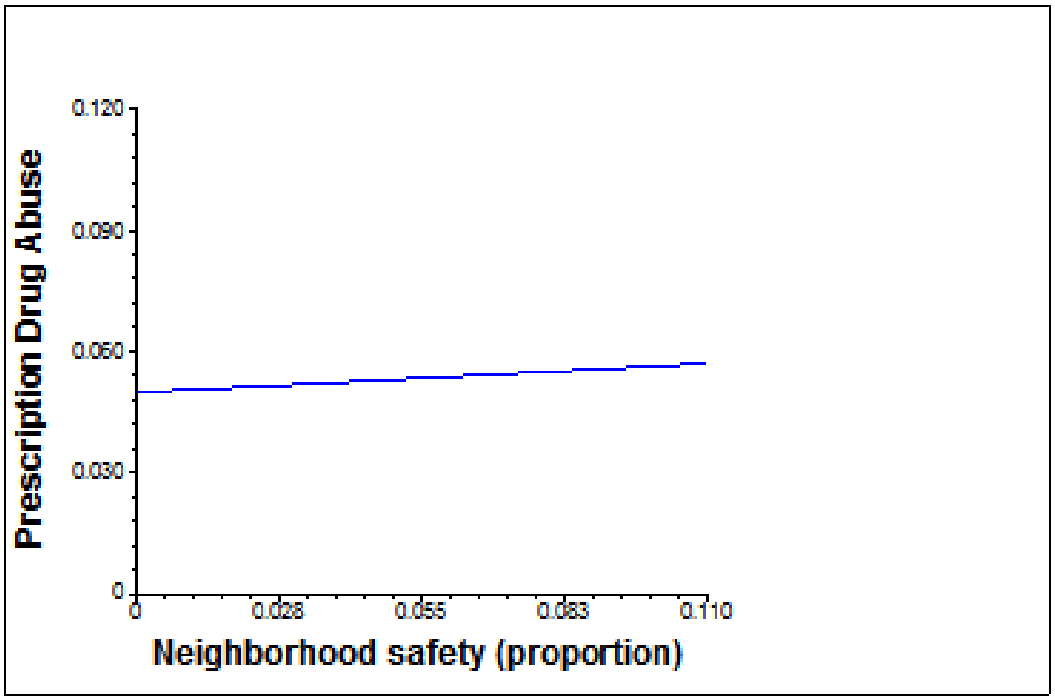


Figure 30- Prescription Drug Abuse by Neighborhood safety (school district level)



Multilevel Logistic Regression

Figure 31- Adjusted Odds Ratios for Prescription Drug Abuse (All Drugs) by Student Level Predictors

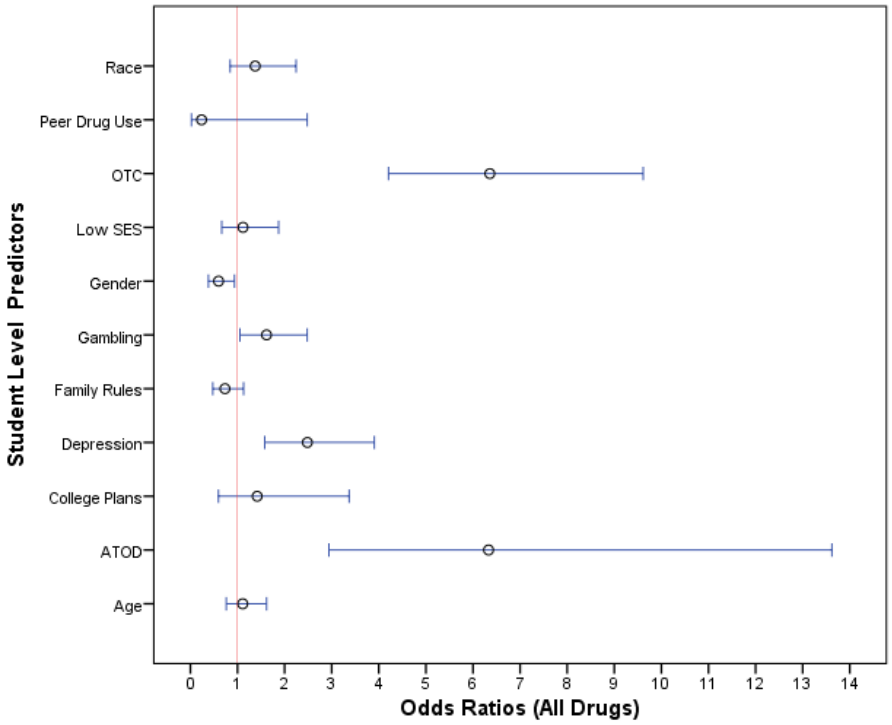


Figure 32- Adjusted Odds Ratios for Downers Abuse by Student Level Predictors

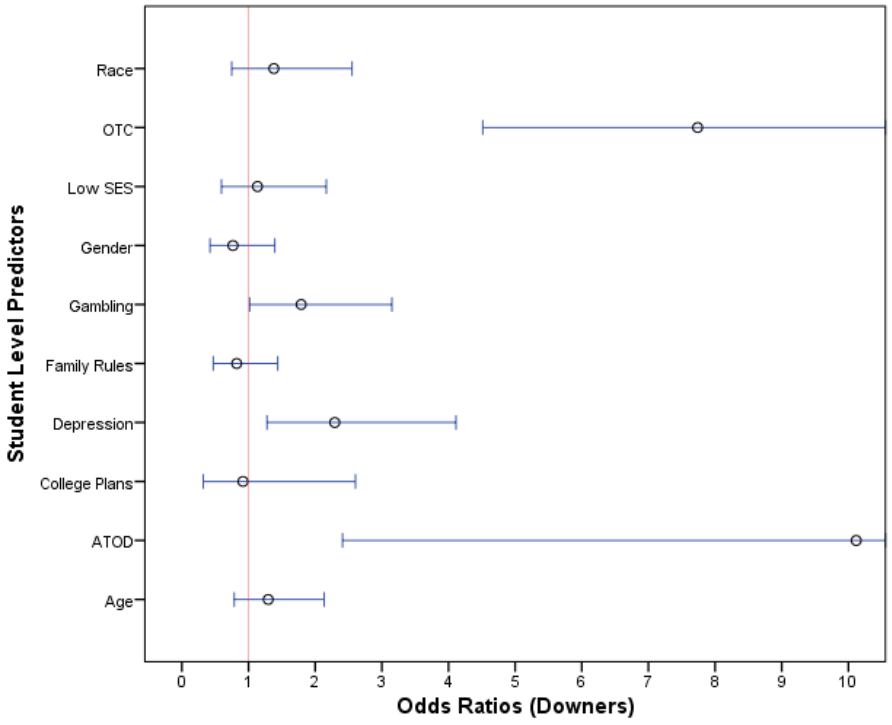


Figure 33- Adjusted Odds Ratios for Uppers Abuse by Student Level Predictors

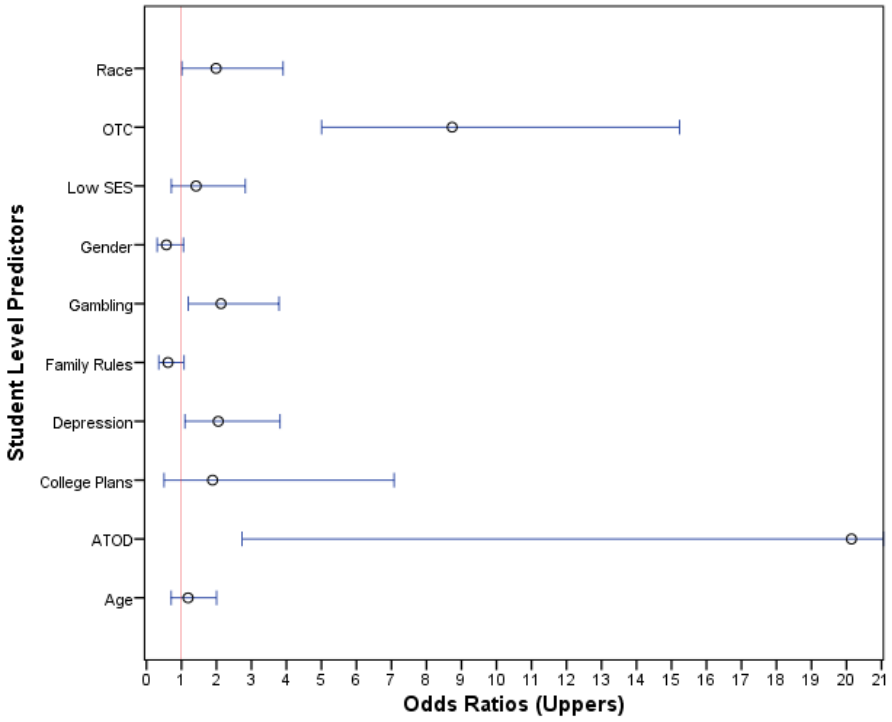


Figure 34- Adjusted Odds Ratios for Other Drug Abuse by Student Level Predictors

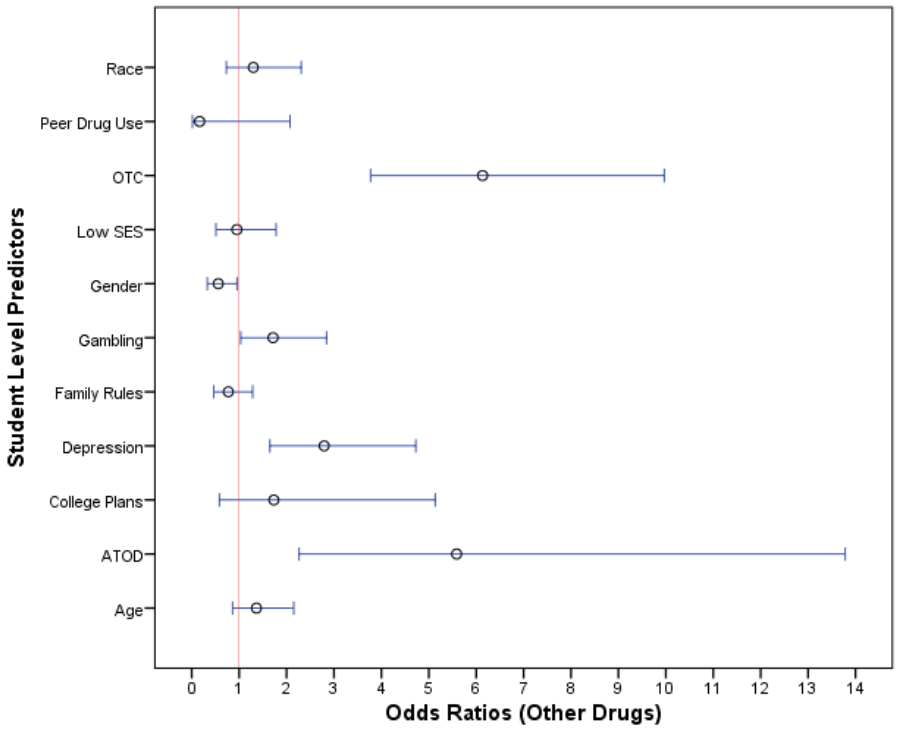
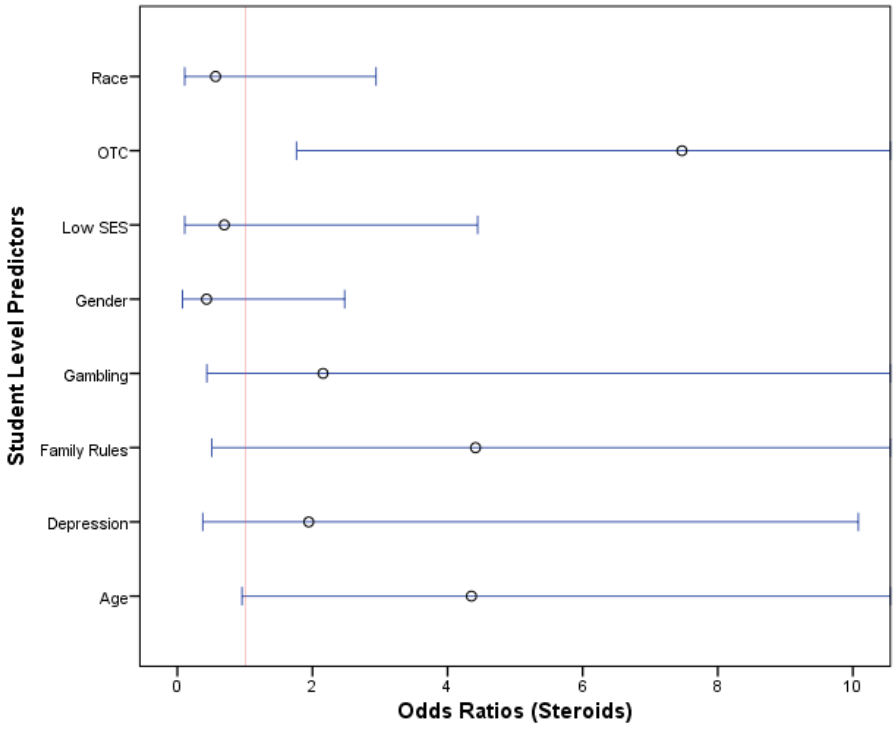


Figure 35- Adjusted Odds Ratios for Steroids Abuse by Student Level Predictors



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