Similarities and Differences in Correlates and Trends in Prescription Stimulant and Prescription Opioid Misuse Among College Students

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SIMILARITIES AND DIFFERENCES IN CORRELATES AND TRENDS IN

PRESCRIPTION STIMULANT AND PRESCRIPTION OPIOID MISUSE

AMONG COLLEGE STUDENTS

by

Julie Murray

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ABSTRACT

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When used as medically intended, prescription opioid and stimulant medications

can have therapeutic benefits. Misuse of these medications, however, presents significant

health risks, including increased morbidity and mortality. Young adults, ages 18 to 25,

have the highest rates of misuse nationally and within this age group, the unique demands

and stressors of a college environment may place college students at particularly high

risk. An existing body of literature has identified predictors and trends for general

prescription misuse, prescription opioid misuse, and prescription stimulant misuse,

however, few studies have directly compared these factors across these classes of

prescription. This two-study dissertation explored factors related to prescription opioid

and prescription stimulant misuse in college students in order to assess similarities and

differences in correlates and trends.

Study #1 assessed for similarities and differences in correlates of prescription

opioid misuse and prescription stimulant misuse, and used random forest and logistic

regression analyses to determine best fit predictive models of each outcome. Study #2 explored perceived risk of prescription misuse, and motive and source of medication misused for initial misuse of prescription opioids and prescription stimulants. Results from study #1 demonstrated that predictive models for prescription opioid misuse and prescription stimulant misuse had similar sensitivity, specificity, and prediction accuracy despite including differing predictor variables. This suggests the importance of considering individual risk factors separately for prescription opioids and stimulants. Results from study #2 revealed a significant relationship between perceived risk and endorsement of lifetime misuse of prescription opioids and/or stimulants, such that high risk perception is associated with abstinence from prescription misuse. There was also a significant relationship between motive for initial misuse and source of initial prescription opioid medication misused. For example, participants who endorsed pain relief motives were most likely to obtain the opioid medication misused from their own prescription (i.e., leftover from an old prescription, taking prescription in a way other than how it was prescribed).

This dissertation identifies similarities and differences in correlates, perceived risk, and factors related to initial misuse of prescription opioid and prescription stimulant medication. Implications, limitations, and future directions were discussed.

(135 pages)

PUBLIC ABSTRACT

Similarities and Differences in Correlates and Trends in Prescription Stimulant and

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When used as medically intended, prescription opioid and stimulant medications can have therapeutic benefits. Misuse of these medications, however, presents significant health risks, including increased risk of death and injury. Young adults, ages 18 to 25, have the highest rates of misuse of prescription opioids and stimulants nationally and within this age group, college students may be particularly at risk. This two-study dissertation explored factors related to prescription opioid and prescription stimulant misuse in college students in order to assess similarities and differences in correlates and trends.

Study #1 assessed for similarities and differences in correlates of prescription opioid misuse and prescription stimulant misuse, and built predictive models of prescription opioid misuse and prescription stimulant misuse. Study #2 examined the relationship between perceived risk of prescription misuse and engagement in misuse of each type of prescription. Additionally, study #2 examined initial motives for misuse and initial source of misused medication for prescription opioid and prescription stimulant misuse. Results from study #1 demonstrated some variation in predictors used for optimized prediction of prescription opioid and stimulant misuse. Results from study #2 revealed that higher perceived risk of prescription misuse is related to lower engagement in prescription opioid and prescription stimulant misuse. Additionally, there was a

significant relationship between initial motive for misuse and initial source of misused medication for prescription opioids, such that participants who engaged in prescription opioid misuse for the first time in order to relieve physical pain were most likely to obtain the prescription opioid medication misused from their own prescription (i.e., leftover from an old prescription, taking prescription in a way other than how it was prescribed). Implications, limitations, and future directions of both studies were discussed.

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Julie Murray

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CHAPTER I

INTRODUCTION

Organizational Overview

The primary purpose of this review is to examine prescription opioid and prescription stimulant misuse among college students. To begin, Chapter I introduces the overarching topic area that was examined in this dissertation: prescription opioid and stimulant misuse in college students, the scope of misuse, and associated risks. Chapters II and III detail two separate research studies that were conducted for this dissertation in which prescription opioid and prescription stimulant misuse were examined in a national sample of college students collected in June 2019. This sample included 616 participants that completed an online survey regarding demographic information and substance use beliefs and behaviors. Chapter II (Study 1) examined correlates of prescription opioid and prescription stimulant misuse, whereas Chapter III (Study 2) examined perceived risk of prescription misuse and initial misuse of prescription opioids and prescription stimulants. Chapters II and III each begin with review of the relevant literature, followed by a description of study objectives, methods, results, and discussion of findings. Finally, Chapter IV discusses overarching findings, implications, and limitations of this dissertation.

College Prescription Opioid and Stimulant Misuse

When used as medically intended, prescription opioids can be effective in the management of both chronic and acute pain conditions (Rosenblum et al., 2018). Prescription stimulants, when used as medically intended, can be used to treat a variety of

conditions including attention-deficit/hyperactivity disorder (ADHD) and narcolepsy (Kroutil et al., 2006). Prescription misuse refers to "taking medicine in a way or dose other than prescribed, taking someone else's prescription, or taking medicine for the effect it causes or to get high" (National Institute on Drug Abuse [NIDA], 2018a). Despite the therapeutic value of these medications, misuse presents significant health risks, including elevated risk of morbidity and mortality (Compton et al., 2016; SAMHSA, 2013). Prescription opioid misuse (POM) accounted for roughly one-third of the estimated 47,609 opioid-related overdose fatalities in the United States in 2018 (Ahmad et al., 2018). Further, in 2016, there was an estimated 358,247 emergency department visits in the United States related to prescription misuse, 41% of which resulted in hospitalization (Geller et al., 2019). Prescription misuse has also been associated with serious side effects and poisoning related to medications used alone or in combination with alcohol or other illicit drugs (Holloway & Bennet, 2012; Kroutil et al., 2006). In addition to the adverse outcomes associated with general prescription misuse, specific classes of prescriptions pose unique risks. For instance, the Center for Disease Control and Prevention [CDC] has recognized POM as the single greatest risk factor for subsequent heroin use (2015). Prescription stimulant misuse (PSM) has also been linked to paranoia, hallucinations, insomnia, and cardiac issues (NIDA, 2018b).

   While past year misuse of prescription opioids and prescription stimulants have declined in people ages 12 or older in recent years (from 4.7% in 2015 to 3.3% in 2020; and 2.0% in 2015 to 1.8% in 2020, respectively), prescription misuse remains a widespread issue and cause for concern (Substance Abuse and Mental Health Services Administration [SAMHSA], 2021). Among people ages 12 and older, prescription pain

relievers (e.g., hydrocodone, oxycodone) were the second most common type of illicit substance use, behind only marijuana (SAMHSA, 2020). Young adults, between the ages of 18 and 25 have been found to have higher rates of each prescription opioid and prescription stimulant misuse than any other age group nationally (SAMHSA, 2021). Within this age group, research suggests that the unique demands and stressors of a college environment place students at very high risk for prescription misuse (McCabe et al., 2006; Schulenberg & Maggs, 2002; Zullig & Divin, 2012). These college-specific factors may include: academic stress, perceived social and cultural norms, separation from familiar social supports, increased independence, and ease of accessibility of prescription medications (McCabe et al., 2006; Schulenberg & Maggs, 2002; Zullig & Divin, 2012). Experimentation and substance use are often thought to be a normative part of a college experience, however they are often not without negative consequences (Skidmore et al., 2016). Substance use in college is associated with poorer academic performance, greater engagement in other risky behaviors, elevated risk of injury, and legal problems (Skidmore et al., 2016). Further, substance use/misuse in college students has been found to predict discontinuous enrollment and increased risk for lack of degree completion (Arria et al., 2013).

There is a large body of research on alcohol use and marijuana use in college students, however there is less published research on prescription medication misuse among this population (Jackson et al., 2020; Knight et al., 2002; Schry & White, 2013; Skalisky et al., 2019; White et al., 2019). To date, PSM has received more attention in the research literature than POM, however, gaps in the literature exist. For instance, most studies have focused on either general/overall prescription drug misuse across all

therapeutic classes or on a single specific class of prescription medication (Advokat et al., 2008; Cabriales et al., 2013; Lanier & Farley, 2011; McCabe et al., 2005; Skidmore et al., 2016; Weyandt et al., 2022). As such, few studies have directly compared predictors of the prescription stimulants and prescription opioids. Limited research in this area has found some variation in risk factors associated with each type of misuse among college students. For instance, one study found identifying as LGBTQ as a risk factor for POM, but not PSM (Kollath-Cattano et al., 2020). The same study found that non-Hispanic White students were more likely than those of other racial/ethnic identities to engage in PSM, but did not find this to be true for POM (Kollath-Cattano et al., 2020). This suggests that prevention efforts may benefit from targeting high-risk subpopulations for each type of prescription misuse. Further, limited research has examined the associations of perceived risk, motives, and source of initial prescription medication misuse in college students. A deeper understanding of the variation in risk factors, initial motivations for misuse, and initial source of misused prescription medication for PSM and POM is essential, as this may lead to more targeted and effective future prevention and intervention programs.

CHAPTER II

STUDY #1 ASSESSING SIMILARITIES AND DIFFERENCES IN CORRELATES

OF PRESCRIPTION OPIOID AND PRESCRIPTION STIMULANT MISUSE

Prescription medication misuse is a widespread problem among college students, with stimulants and opioids being the most commonly misused classes of prescription medication (Schulenberg et al., 2019). Prevalence rates of prescription medication misuse among college students have varied across studies, but some studies have estimated rates as high as 17% for prescription stimulant misuse (PSM) and 20% for prescription opioid misuse (POM; Benson et al., 2015; Weyandt et al., 2022). The widespread misuse of these types of prescription medications in college students is cause for concern, as prescription medication misuse is associated with high addiction potential, health risks, and legal difficulties (McCabe et al., 2009; Zullig & Divin 2012). Further, substance use in college students has been found to predict inconsistent enrollment and poor retention (Arria et al., 2013).

There has been an abundance of research into sociodemographic, psychological, and substance use correlates of prescription medication misuse in college students. Most studies, however, have focused on either general prescription medication misuse, without differentiating between classes of prescriptions or on only one class of prescription misuse (Advokat et al., 2008; Cabriales et al., 2013; Lanier & Farley, 2011; McCabe et al., 2005; Skidmore et al., 2016; Weyandt et al., 2022). Across studies, however, some factors have been consistently identified as associated with both PSM and POM in college students. For example, sociodemographic factors including being non-Hispanic, White, male, having Greek life (i.e., sorority or fraternity) affiliation, and having a lower

GPA have been consistently identified as associated with both PSM and POM in college students (Benson et al., 2015; Weyandt et al., 2022). Further, previous literature has consistently demonstrated a relationship between prescription misuse and engagement in other types of substance use, including tobacco use, alcohol use, binge drinking, marijuana use, and illicit drug use (Arria & Dupont, 2010; McCabe et al., 2005; McCabe et al., 2015; Sepúlveda et al., 2011). In addition to sociodemographic and substance use predictors, some research has linked prescription misuse to psychological factors, such as depression, anxiety, and increased stress, in college students and particularly in nursing and medical students (De Bruyn et al., 2019; Ne'Eman-Haviv & Bonny-Noach, 2019; Schepis et al., 2020). Further, the existing body of literature suggests that social factors, including perceived acceptability of misuse, perceived parental and peer attitudes towards misuse, perceived risk of misuse, and having friends that engage in substance use may be associated with engagement in prescription misuse (Ford & Ong, 2014; Maahs et al., 2016; Murray, 20202; Peralta & Steele 2020; Watkins, 2016).

      While there are similarities in some trends across different types of prescription medications misuse, some differences between classes of prescription medications misused have also been identified. For instance, while rates of POM among college students and their non-student peers are similar, rates of PSM have been found to be higher among college students than their non-student peers (Schulenberg et al., 2019). Further, while the lifetime trajectories of PSM and POM are similar, with an increase in adolescence and a peak in early adulthood, the slope of the decline after early adulthood differs between the prescription classes, with rates of PSM being much lower in older adults relative to POM (Austic et al., 2015; Schepis & McCabe, 2016; Substance Abuse

and Mental Health Services Administration [SAMHSA], 2019). In addition to differences in prevalence rates across lifespan and educational status, some differences have also been observed in motives for misuse (Schepis et al., 2020). While getting high and experimentation are commonly reported motives for both PSM and POM, other frequently endorsed motives differ between these classes of prescriptions (Schepis et al., 2020). In adults, ages 18 and older, the most commonly reported motive for PSM is to increase alertness or concentration, whereas the most commonly reported motive for POM is pain relief (Schepis et al., 2020).

Given these differences in trends and motives for PSM and POM, there is reason to believe that predictors of each class of prescription misuse may differ as well. These differences may be important, as a better understanding of how sociodemographic, substance use, and psychosocial predictors are differentially associated with each class of prescription misuse may allow for screening and prevention efforts to better target those at most risk for misuse of each class of prescription.

Conclusions from the Literature

Given the concerning rates of PSM and POM among college students and the associated risk of physical, mental health, legal, and academic consequences, it is essential to further benchmark rates of misuse and gain a better understanding of the factors associated with each of these types of misuse. Previous research has established some overlap in predictors of PSM and POM. Much of the previous literature, however, has focused on either general prescription medication misuse, without differentiating between classes of prescription medication, or have focused on only one class of

prescription medication misuse. Identified differences in trends and motives for PSM and POM suggest there may also be differences in predictors of each class of prescription medication misuse. Understanding how predictors are differentially associated with each class of prescription medication misuse may be important, as it can help to inform screening and prevention efforts to better target those at most risk for misuse of each class of prescription medication.

Research Purpose and Study Objectives

This study sought to identify similarities and differences in correlates of POM and PSM. This purpose was realized through the following research objectives:

1) To describe prescription opioid and prescription stimulant misuse within the sample of undergraduate college students in terms of prevalence, frequency, and types of medications misused.

2) To examine sociodemographic, substance use, psychosocial correlates of prescription opioid and prescription stimulant misuse within the sample of undergraduate college students.

3) To build multivariate models of prescription opioid and prescription stimulant misuse that optimize prediction of undergraduate college students most at risk for misuse.

Methods

Participants

Participants were drawn from an extant cross-sectional dataset from a previous study that employed a web-based survey, designed to assess substance use behaviors, predictors, motives, perceived risk and perceived peer attitudes towards prescription misuse in a national sample of undergraduate students. The previous study collected data in June 2019 from 616 undergraduate students enrolled full-time (i.e., enrolled at least twelve credits) at four-year universities in the United States of America who were at least 18 years of age.

Procedure

Survey respondents were obtained via Qualtrics Panel which uses traditional actively managed market research panels in order to aggregate samples that meet the inclusion and exclusion criteria provided by the researcher. Those eligible for inclusion in the study were full time college students (i.e., enrolled at least 12 credits) in four-year universities in the United States of America that were at least 18 years of age. Prospective participants who were likely to meet this study criteria based on their Qualtrics profile were invited via email to take part in the survey. Participants who met the criteria and completed the survey were incentivized in a variety of forms (e.g., airline miles, gift cards, vouchers) based on the length of survey, their specific panelist profile, and difficulty of sample acquisition for the survey. The use of this type of online panel data

has been supported by meta-analyses that have found both conventionally sourced and aggregated samples to have similar psychometric properties (Walter et al., 2018).

To protect the anonymity of survey respondents, respondents who met inclusion criteria to participate in the study were provided an electronic letter of information and were to mark it as "read" prior to survey completion (see Appendix A). The survey utilized conditional branching, a technique that helps respondents navigate surveys by leading them to the next appropriate question and automatically by-passing items that are not applicable to them (Norman & Pleskac, 2002). This technique has been found to significantly reduce survey completion time and potentially some aspects of respondent burden, such as length of survey and ease of survey navigation, that can negatively impact data quality (Briz-Redón, 2021; Galesic & Bosnjak, 2009; Norman & Pleskack, 2002; Sharp & Frankel, 1983).

Data were collected in June 2019. After data collection, validity checks (e.g., fast responses, patterned responses, inconsistent responses between endorsement of misuse and frequency of misuse of outcome variables POM and PSM) were conducted. Those who failed at least one validity check were removed from analysis (n=59). This left a total of 616 survey completers.

Data and Instrumentation

The measures described below were chosen to gather information relevant to sociodemographic information, substance use behaviors, and psychosocial factors. Table 1 summarizes the study variables included in this study. The survey was administered

through Qualtrics Survey Research Suite, a web-based tool available for use through Utah State University. The survey in its entirety is located in Appendix B.

Demographics Information

A demographic questionnaire was used to collect demographic information, including biological sex, relationship status, ethnic identity, student classification, GPA, and residency type.

Prescription Misuse

Lifetime, past year, and past 30-day prescription opioid misuse (POM) and prescription stimulant misuse (PSM) were assessed by presenting respondents with a list of the most common names of opioid and stimulant medications, acquired from the National Institute on Drug Abuse, and two items asking the respondents to indicate which medication had ever been misused and how often the medication has been misused. Misuse was defined for the respondents as "taking medicine in a way or dose other than prescribed, taking someone else's prescription, or taking medicine for the effect it causes or to get high" (NIDA, 2018). The response scale was as follows: (1) never used; (2) used, but not in the past 12 months; (3) used, but not in the past 30 days; and (4) used in the past 30 days. For both classes of medication, participants who indicated any lifetime misuse were also assessed for the amount of times they had misused the medication, with response options ranging from "once" to "more than ten times."

Other Substance Use

Alcohol use, tobacco use, marijuana use, and other illicit drug use were also assessed, as previous research has found strong associations between prescription misuse and other substance use behaviors (McCabe et al., 2005; Schroeder & Ford, 2012; Teter

et al., 2003). Use of these substances were assessed in nine items in which respondents were asked to indicate if they have used/misused each substance and the frequency of use/misuse. Binge drinking was defined as five or more drinks in one sitting. Those who endorsed past 30-day alcohol use were assessed for frequency of binge within those past 30 days.

Peer Substance Use Behaviors

Peer substance use behaviors were measured using three items adapted from previous research investigating the connection between various forms of substance use and social learning theory (Akers et al., 1979; Peralta & Steele, 2010; Watkins, 2016). These items asked how many of the respondent's close friends engage in substance use behaviors, such as binge drinking, using marijuana/other illicit drugs, and misusing prescription drugs. The response scale for each item was: (1) none of my friends; (2) a few of my friends; and (3) some of my friends; (4) most of my friends; (5) all of my friends.

Perceived Risk and Attitudes towards Prescription Misuse

Perceived risk and attitudes towards prescription misuse were measured with four items adapted from Watkins (2016). The first item asked respondents about the perceived risk college students face when misusing prescription medications (physically or otherwise), with responses ranging from (1) not risky to (4) very risky. The second and third items asked about the attitudes the respondent feel their peers and parents would hold toward prescription medication misuse, with responses ranging from (1) very negative to (5) very positive. And the fourth item asked respondents to what degree they

feel prescription medication misuse is acceptable, with responses ranging from (1) not acceptable to (5) very acceptable.

Depression

The Patient Health Questionnaire Depression Scale (PHQ-9) is a nine item self-report screener of depression severity based on the DSM-IV criteria for depressive disorders (Kroenke et al., 2001). This measure has high internal reliability (alpha= 0.89) and test-retest reliability (alpha= 0.84; Kroenke et al., 2001). Scores on this measure range from 0-27, with higher scores indicating more severe depression.

Anxiety

The Generalized Anxiety Disorder 7-Item (GAD-7) is a brief self-report screener of anxiety (Spitzer et al., 2006). Scores on this item range from 0 to 21 with cut points at 5, 10, and 15 to represent mild, moderate, and severe anxiety. Using a score of 10 as the cut-point, the GAD-7 has sensitivity of 89% and specificity of 82% for generalized anxiety disorder. This measure is also moderately good at screening for other anxiety and trauma-related disorders including panic disorder, social anxiety disorder, and post-traumatic stress disorder (Williams, 2014).

Stress

The Perceived Stress Scale (PSS) is a ten-item measure of perceived stress (Cohen et al., 1983). This measure has high reliability (alpha= 0.85 for two-day retest and 0.55 for 6-week re-test; Cohen et al., 1983).

Table 1

Summary of Study Variables

Variables	Method of assessment
Demographic Variables	
Age	Age in years
Sex	Sex assigned at birth: male, female
Race/Ethnicity	American Indian/Alaskan Native, Asian, Black/African American, Hispanic/Latinx, Native Hawaiian/Pacific Islander, White, Other
Relationship Status	Single, married, separated/divorced/widowed, in a committed relationship
Student Classification	Freshman, sophomore, junior, senior
GPA	GPA
Residency Type	Current living arrangement
Substance Use Behaviors	
Prescription Opioid Misuse	Prescription opioid medication misused, frequency
Prescription Stimulant Misuse	Prescription stimulant medication misused, frequency
Tobacco	Tobacco use, frequency
Alcohol	Alcohol use, frequency, past 30-day binge drinking
Marijuana Use	Marijuana use, frequency
Other Illicit Drug Use	Other illicit drug use, frequency
Psychosocial Factors	
Peer Substance Use	Amount of friends who engage in binge drinking, illicit drug use (including marijuana), and prescription misuse
Perceived Risk	Perceived risk
Perceived Attitudes	Personal and perceived peer/parent attitudes towards prescription medication misuse
Stress	Perceived Stress Scale (PSS)
Depression	Patient Health Questionnaire (PHQ-9)
Anxiety	Generalized Anxiety Disorder 7-Item (GAD-7)

Analytic Plan

The first objective was to describe the prevalence, frequency, and types of prescription opioids and prescription stimulants misused among undergraduate college students. In order to address this research question, descriptive statistics, including frequencies and percentages, were used to describe the sample according to misuse variables.

The second research objective was to examine correlates of POM and PSM in undergraduate college students. In order to address the second research objective, bivariate associations were explored between each sociodemographic, substance use and psychosocial variable and prescription misuse. Chi-square tests of independence were used to examine the relationships between categorical predictor variables and the outcome variable. Analysis of variance (ANOVA) was used to examine the relationships between continuous predictor variables and the outcome variable. Given that 45% of participants who endorsed misusing prescription medications endorsed both POM and PSM, a new outcome variable was created that had four levels: no endorsement of any misuse; endorsed lifetime POM only, with no endorsement of PSM; endorsed lifetime PSM only, with no endorsement of POM; and lifetime poly-prescription misuse (PPM). This allowed for the assessment of potential similarities and differences in correlates amongst the different types of misuse.

The third research objective was to build multivariate models of PSM, POM, and PPM that can potentially optimize prediction in undergraduate college students. In order to address this question, we used a two-step approach, using random forest for variable selection followed by logistic regression. In the current sample, there are 616

participants, however only 105 endorsed prescription opioid misuse, 107 endorsed prescription stimulant misuse, and 66 endorsed lifetime PPM. As is expected in substance use research, this is a highly imbalanced sample, which could result in a high likelihood of Type II error and thus low prediction accuracy if all 22 predictor variables were used in a logistic regression (Han et al., 2020). Recent research suggests that machine learning, specifically random forest, may provide improved predictive performance over logistic regression particularly with highly imbalanced data (Alghamdi et al., 2017; Chiew et al., 2020; Han et al., 2020). Additionally, machine learning methods have been found to mitigate some issues of multicollinearity among predictor variables (e.g., depression and anxiety), as machine learning does not assume independence of predictors (Altman & Kryzwinski, 2018; Goin et al., 2018). Machine learning techniques for developing predictive models have been leveraged in health care research, including to predict early TBI mortality (Anorim et al., 2020), cancer prognosis and survival (Kourou et al., 2015; Ganggayah et al., 2019), and hospital readmission (Huang et al., 2021). These approaches use computational learning and pattern recognition to take into account all possible interactions, including nonlinear interactions, and create flexible and reliable predictive models (Dreiseitl & Ohno-Machado, 2002; Han et al., 2020).

Several recent studies have applied machine learning techniques to better understand prescription medication misuse (Dong et al., 2019; Han et al., 2020; Kalyanam et al., 2017; Mackey et al., 2018). One such study compared logistic regression to three methods of machine learning in the prediction of prescription opioid misuse in a national sample of adolescents and found random forest to perform best in terms of prediction accuracy, followed by logistic regression (Han et al., 2020). Random forest

generates a non-linear prediction model based on the aggregation of classification and regression trees, thus optimizing predictive ability (James et al., 2013). One disadvantage of random forest is that it provides a ranking of importance of predictors, but does not provide interpretable coefficients, like logistic regression. As such, it is suggested that random forest and logistic regression be used together as complimentary analyses in order to harness the strengths of each approach (Han et al., 2020). In this way, random forest can be used to mitigate issues related to the imbalanced sample and multicollinearity of predictors for variable selection, and then logistic regression can be used to add interpretability to the predictive model (Vellido et al., 2020).

The present study used this two-step approach. First, random forest classification was used to identity important predictors for each outcome variable. Random forest aggregates many individual decision trees in order to improve predictive performances of the trees. Random forest algorithms account for only a random subset of predictors at each split in the tree (Brieman, 2001). At each node, the point where the data is split based on some characteristic, a random sample of predictors (m) is chosen as the potential split characteristic, from the full set of predictors (p). Each split uses only one of the "m" predictors. Further, each new split in a tree pulls from a new sample of "m" predictors. Typically "m" is approximately the square root of "p" (Gautam & Singh, 2020). In this study, p=22 and m=5. All sociodemographic, substance use, psychosocial predictors were considered in the random forest with the outcome variables being lifetime POM, lifetime PSM, and lifetime PPM.

Random forest provides two measures of variable importance for each variable in the model, one based on mean decrease accuracy and another based on Gini impurity.

The mean decrease accuracy (MDA) measure has been found to be a more reliable and less biased measure of variable importance, as the Gini-based variable importance measure has been shown to have preference for certain types of predictors, such as continuous predictors and categorical predictors with many options (Janitza et al., 2013; Nicodemus & Malley, 2011; Strobl et al., 2007). The MDA measure of variable importance measures the difference between the out- of-bag error rate after and before permuting the values of the predictor of interest. Put simply, the MDA measure of variable importance measures the average of how much removing a variable decreases prediction accuracy. The greater the decrease in prediction accuracy, the more important the variable is to the model. The MDA variable importance measure has been found to have some limitations for variable selection in unbalanced samples (Janitza et al., 2013). As such, an AUC permutation-based measure of variable importance is recommended for variable selection in unbalanced samples (Bradter et al., 2022; Janitza et al., 2013). However, research comparing MDA variable importance measures to AUC permutation based variable importance measures has demonstrated that with a sample size of 500 and a class imbalance of around 20%, there is virtually no differences between the two measures of variable importance (Janitza et al., 2013). Thus, based on the sample size of the present study ($n = 616$) and the amount of imbalance (~17%), the literature suggests the MDA based variable importance measure is adequate for variable selection. As such, the present study selected variables based on the MDA measure of variable importance.

In order to add interpretable coefficients to the predictor variables, logistic regression models were then created using the identified most important predictors for each outcome variable. The statistical analysis program R version 4.2.2 was used to

conduct descriptive, correlational, and logistic regression analyses (R Core Team, 2021).

Random forests were created using the randomForest package version 4.7-1.1 (Liaw &

Wiener, 2002).

Results

Missing Data

Previous literature suggests that compensation and reduced respondent burden

increase survey completion rates (Briz-Redón, 2021; Kost & de Rosa 2018). Participants

in the present survey were compensated in a variety of ways via Qualtrics for their

participation and respondent burden was addressed through conditional branching. This

may, in part, explain the limited number of missing values in the present analyses. Of the

variables included in the present study, only grade point average (GPA) had missing

values. Of note, GPA was the only variable in this study that required participants to

"write in" their response, rather than select from provided response options. One hundred

and thirty six of the 616 participants in the study did not disclose their grade point

average (GPA). There were no statistically significant differences between those who

reported GPA and those who did not in age, sex, relationship status, or residency type.

There was, however, a significant difference in race between those who reported their

GPA and those who did not such that non-white participants were more likely to have a

missing value for GPA than white participants, X^2 (1) = 6.96, $p < .05$ (see Figure 1).

There was also a significant difference in student classification such that freshman were

more likely to have a missing value for GPA than sophomores, juniors, or seniors. X^2 (3)

= 59.02, $p < .001$ (see Figure 2). Those with missing values for GPA were not included in

descriptive analyses. For bivariate associations and model building, median permutation was used to address missing values for GPA.

Figure 1

GPA Missingness by Race
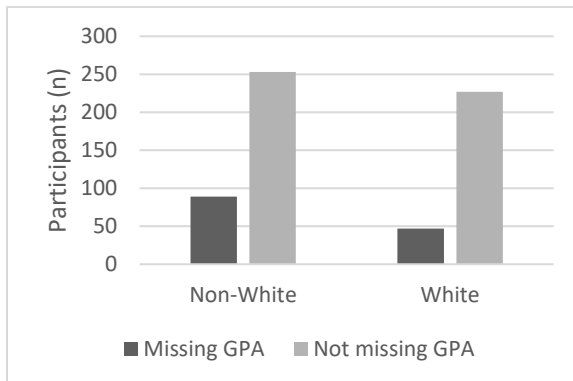
Figure 2

GPA Missingness by Student Classification
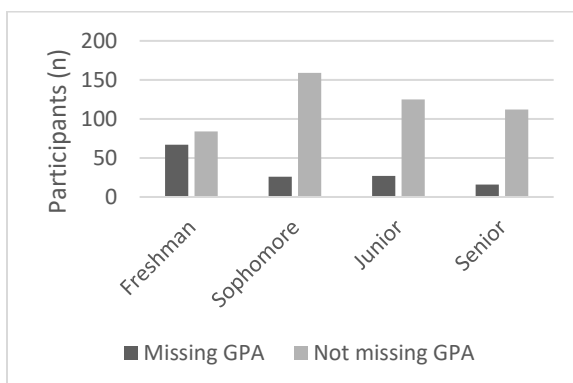
Sample Demographics

Table 2 presents a summary of all demographic characteristics for the sample ($n =$ 616). The age of participants ranged from 18 to 63 with the median age of 20. The

majority identified as single (62%), female (87%), non-White (54%), and lived outside of their parents'/guardians' home (63.5%).

Table 2

Means, Standard Deviations, Frequencies, and Percentages for Demographics in Sample

Sociodemographic variable	*n*	%	M *(SD)*
Age			21.8 (5.5)
Sex			
Female	536	87.0	
Male	80	13.0	
Race/ethnicity			
American Indian or Alaska Native	20	3.2	
Asian	50	8.1	
Black or African American	149	24.2	
Hispanic or Latinx	109	17.7	
Native Hawaiian or Pacific Islander	5	.8	
White	274	44.5	
Other	9	1.5	
Student classification			
Freshman	151	24.5	
Sophomore	185	30.0	
Junior	152	24.7	
Senior	128	20.8	
Relationship status			
Single (not involved)	382	62.0	
In a committed romantic relationship	192	31.2	
Married	37	6.0	
Divorced	4	.6	
Separated	1	.2	
GPA			3.38 (.50)
Residency type			
Residence hall/on-campus housing	191	31.0	
Fraternity/sorority housing	46	7.5	
Parent/guardian's home	225	36.5	
Other off-campus housing	154	25.0	

Objective #1: Describe POM and PSM

The first research objective was to describe POM and PSM within the sample of undergraduate college students. To address this, participants were asked to indicate which prescription medications from lists of the most common opioid and stimulant medications, per the National Institute on Drug Abuse, if any they had misused, with the option to select "other." Participants were then asked to indicate how often and how many times they had misused prescription stimulant and/or opioid medications. Seventeen percent of participants indicated POM at least once in their lifetime, 8.8% endorsed past year misuse, and 1.5% endorsed past month misuse. Among the 105 participants who indicated lifetime POM, oxycodone (e.g., OxyContin & Percocet) was the most reported opioid medication misused (42.9%), followed by hydrocodone (e.g., Vicodin; 41%). Frequencies and percentages of recency, frequency, and types of opioid medication misused within the total sample and within the subsample of participants that indicated lifetime POM are included in Table 3.

Seventeen percent of participants indicated PSM at least once in their lifetime, 8% endorsed past year misuse, and 1.9% endorsed past month misuse. Among the 107 participants who indicated lifetime PSM, dextroamphetamine (e.g., Adderall) was the most reported stimulant medication misused (74.8%), followed by methylphenidate (e.g., Ritalin, Concerta; 26.2%). Table 4 shows frequencies and percentages of recency, frequency, and type of prescription stimulant misused within the sample and within the subsample of participants that indicated lifetime PSM.

Of the 146 participants that indicated misuse of at least one type of prescription medication, 66 (45%) endorsed misuse of both prescription opioids and prescription

stimulants at least once in their lifetime. Thirty nine participants endorsed misuse of prescription opioids, but never prescription stimulants and 41 participants endorsed misuse of prescription stimulants, but never prescription opioids.

Table 3

Frequencies and Percentages for Prescription Opioid Misuse

	n	Percentage of Lifetime POM subsample (n = 105)	Percentage of total sample (n = 616)
Never misused	509	0	82.6
Lifetime misuse	105	100	17.0
Past year misuse	54	51.5	8.8
Past 30 day misuse	9	8.6	1.5
Misused once	29	27.6	4.7
Misused 2-5 times	45	42.9	7.3
Misused 6-9 times	12	11.4	1.9
Misused more than 10 times	17	16.2	2.8
Hydrocodone (Vicodin)	43	41.0	7.0
OxyCodone (OxyContin/Percocet)	45	42.9	7.3
Oxymorphone (Opana)	12	11.4	1.9
Morphine (Kadian/ Avinza)	17	16.2	2.8
Codeine (Tylenol 3)	37	35.2	6.0
Fentanyl	9	8.6	1.5
Other prescription opioid misuse	2	1.9	.3

Table 4

Frequencies and Percentages for Prescription Stimulant Misuse

	n	Percentage of Lifetime PSM subsample (*n = 107*)	Percentage of total sample (*n = 616*)
Never misused	509	0	82.6
Lifetime misuse	107	100	17.4
Past year misuse	51	47.6	8.3
Past 30 day misuse	12	11.2	1.9
Misused once	18	16.8	2.9
Misused 2-5 times	58	54.2	9.5
Misused 6-9 times	14	13.1	2.3
Misused more than 10 times	17	15.9	2.8
Dextroamphetamine (Dexedrine)	18	16.8	3.7
Dextroamphetamine/amphetamine combination product (Adderall)	80	74.8	13.8
Methylphenidate (Ritalin, Concerta)	28	26.2	4.5
Lisdexamfetamine (Vyvanse)	11	10.3	2.1
Other prescription stimulant misused	1	.9	.3

Objective #2: Correlates of POM and PSM

The second research objective was to examine correlates of prescription opioid and prescription stimulant misuse by exploring the bivariate relationships between sociodemographic, substance use, psychosocial variables and POM, PSM, and PPM within the sample of undergraduate college students. In order to do so, one outcome variable "misuse" was created, with levels coded into "no misuse," "lifetime POM only," "lifetime PSM only," and "lifetime PPM."

Sociodemographic Variables

Chi-square tests of independence were performed to examine the relationships between misuse and the categorical sociodemographic variables including sex, race/ethnicity, relationship status, residency type, and student classification. In order to determine the strength of association, Cramer's V was calculated. Chi-square tests of

independence assume independence of observations, mutually exclusive and exhaustive categories, and that no more than 20% of expected frequencies are less than 5. These assumptions were met for sex and student classification. The variables race, relationship status, and residency type had more than 20% of cells with less than an expected frequency of five and thus violated the expected frequency assumption. In order to meet this assumption, race was recoded into a dichotomous variable, white and non-white, and relationship status was recoded into a dichotomous variable, single/uninvolved and in a romantic relationship. Residency was recoded so that the response options "fraternity or sorority housing" and "on campus/ residence hall" were collapsed into "campus affiliated housing."

ANOVA was used to examine the relationship between the categorical variable misuse and the continuous sociodemographic variables age and GPA. In order to determine the strength of the association, partial eta squared was calculated.

Chi-square statistics revealed a significant relationship between misuse and sex, X^2 (3, $n = 616$) $= 8.89$, $p = .03$. The effect size for this relationship was small ($\varphi = .10$). Chi-square statistics also revealed a significant relationship between misuse and residency type X^2 (6, $n = 616$) $= 14.55$, $p = .024$. Age was found have a significant effect on misuse such that on average participants endorsing POM only were significantly older than those who denied any misuse, F(3, 612)= 2.93, $p < .05$. The effect size for this relationship was small, $\eta_p^2 = 0.01$. Sociodemographic variables stratified by misuse are reported in Table 5.

Table 5

Means, Standard Deviations, Frequencies, and Percentages for Demographics in Total Sample and Stratified by Misuse

	Total Sample (n = 616)		No misuse (n = 470)		POM (n = 39)		PSM (n = 41)		PPM (n = 66)		Test	ES[a]
	n	%	n	%	n	%	n	%	n	%		
Age	21.8 (5.4)		21.5 (5.03)		23.7 (7.3)		22.2 (7.7)		22.8 (5.1)		$F_{(3, 612)}=$ 2.93*	$\eta_p^2 =$ .01
Sex											$X^2_{(3)}= 8.89*$	.10
Female	536	87.0	419	89.1	32	82.1	34	82.9	51	77.3		
Male	80	13.0	51	10.9	7	17.9	7	17.1	15	22.7		
Race											$X^2_{(3)}= 6.02$	
White	342	55.5	269	57.2	15	38.5	20	48.8	38	57.6		
Non-White	274	44.5	201	42.8	24	61.5	21	51.2	28	42.4		
Living Arrangement											$X^2_{(6)}=14.55*$	.08
Campus affiliated	237	38.5	177	37.7	13	33.3	11	26.8	36	54.5		
Off campus	154	25.0	112	23.8	10	25.6	15	36.6	17	25.8		
Parent/guardian's home	225	36.5	181	38.5	16	41.0	15	36.6	13	19.7		
Student Classification											$X^2_{(9)}=14.52$	
Freshman	151	24.5	117	24.9	16	41.0	7	17.1	11	16.7		
Sophomore	185	30.0	135	28.7	11	28.2	15	36.6	24	36.4		
Junior	152	24.7	114	24.3	9	23.1	13	31.7	16	24.2		
Senior	128	20.8	104	22.1	3	7.7	6	14.6	15	22.7		
GPA	3.4 (0.5)		3.4 (0.5)		3.5 (0.4)		3.3 (0.4)		3.4 (0.4)		$F_{(3, 476)}=$ .88	

[a] Effect sizes calculated using Cramer's V unless otherwise specified
*$p<.05$
***$p< .0001$

Substance Use Variables

Substance use variables included other types of substance use outside of prescription opioid and stimulant misuse, such as tobacco use, alcohol use, binge drinking, marijuana use, and illicit drug use. Almost 36% of participants endorsed tobacco use, with about 15% endorsing past 30-day use. Of the 240 participants who endorsed past 30-day alcohol use, 70% endorsed binge drinking within that month. A little less than half of participants (46%) endorsed having used marijuana at least once within their lifetime, and about 34% of those who had tried marijuana endorsed using marijuana more than five times. About 19% of participants endorsed some type of illicit drug use in their lifetime. Cocaine was the most reported illicit drug used (10%), followed by Ecstasy or MDMA (8.3%).

All assumptions of chi-square test of independence were met for all lifetime substance use variables, as well as past 30-day binge drinking. Unsurprisingly, chi-square tests of independence demonstrated significant relationships between each type of substance use and prescription misuse. The relationship between prescription misuse and illicit drug use had the largest effect size (Cramer's V = .60), followed by the relationship between prescription misuse and tobacco (Cramer's V = .45). Substance use stratified by prescription misuse, chi-square statistics, and effect sizes are shown in Table 6.

Table 6

Frequencies and Percentages for Lifetime Substance Use Variables Stratified by Misuse

	Total Sample (n = 616)		No misuse (n = 470)		POM (n = 39)		PSM (n = 41)		PPM (n = 66)		X^2	Cramer's V
	N	%	n	%	n	%	n	%	n	%		
Tobacco											$X^2(3)=129.50$***	.45
No	396	64.3	357	76.0	11	28.2	19	46.3	9	13.6		
Yes	220	35.7	113	24.0	28	71.8	22	53.7	57	86.4		
Alcohol											$X^2(3)=34.20$***	.23
No	175	28.4	161	34.3	6	15.4	3	7.3	5	7.6		
Yes	441	71.6	309	65.7	33	84.6	38	92.7	61	92.4		
Binge drinking[a]											$X^2(3)=27.26$***	.39
No	448	72.7	362	77.0	25	64.1	17	41.5	44	66.7		
Yes	168	27.3	108	23.0	14	35.9	24	58.5	22	33.3		
Marijuana											$X^2(3)=97.88$***	.39
No	331	53.7	304	64.7	8	20.5	11	26.8	8	12.1		
Yes	285	46.3	166	35.3	31	79.5	30	73.2	58	87.9		
Illicit Drugs											$X^2(3)=228.1$***	.60
No	501	81.3	439	93.4	21	53.8	27	65.9	14	21.2		
Yes	115	18.7	31	6.6	18	46.2	14	34.1	52	78.8		

[a] Binge drinking was assessed for past 30-day binge drinking only, not lifetime

*** $p < .0001$

Psychosocial Variables

Psychosocial variables included depression, as measured by the Patient Health Questionnaire Depression Scale (PHQ-9); anxiety, as measured by the Generalized Anxiety Disorder 7-Item (GAD-7); perceived stress, as measured by Cohen's Perceived Stress Scale (PSS); peer substance use behaviors, including amount of friends who binge drink, amount of friends who engage in illicit substance use (including marijuana), and amount of friends who engage in prescription misuse; perceived risk of prescription misuse, perceived peer and parental attitudes towards prescription misuse; and perceived acceptability of prescription misuse.

The average PHQ-9 score was 10.33 (SD = 7.13). On the PHQ-9, a score of less than 10 indicates minimal to mild depression (Kroenke et al., 2001). About half of participants in the present study (50.8%) had scores that fell within this range, while 49.2% of participants had scores of 10 or greater indicating moderate to severe depression. The average GAD-7 score was 9.13 (SD =6.18). A score of less than 10 on the GAD-7 indicates minimal to mild anxiety, while scores of 10 or above indicates moderate to severe anxiety (Spitzer et al., 2006). In the present study, a small majority of the sample (54.4%) had scores that fell within the minimal/mild anxiety range and 45.6% of participants had scores of 10 or above indicating moderate to severe anxiety range. The average PSS score was 19.55 (SD= 6.01). On this measure, scores 27 or greater indicates high perceived stress. Fifteen percent of participants in the present study had scores that fell within the high perceived stress range.

In regards to peer substance use behaviors, the majority of participants indicated that at least a few of their friends binge drink (55%) and engage in illicit drug use (70%).

Conversely, only 31.5% of participants indicated that they had at least a few friends who engage in prescription misuse. In regards to perceived risk and attitudes towards prescription misuse, about 10% of participants indicated that they did not find prescription misuse to be risky (physically, legally, or otherwise). About 62% of participants indicated that they perceived their peers held somewhat or very negative attitudes towards prescription misuse, while 80% of participants indicated that their parents held somewhat or very negative attitudes towards prescription misuse. Only 8% of participants indicated that they felt misusing prescription medication was somewhat or very acceptable, 12% of participants felt neutral towards misusing prescription medication, and 79.5% of participants felt it is not acceptable or somewhat unacceptable.

The three peer substance use behaviors variables (i.e., amount of friends who binge drink, amount of friends who use illicit drugs, and amount of friends who misuse prescription medications) violated the chi-square test of independence assumption of expected frequencies due to having a small number of participants who endorsed "most of my friends" or "all of my friends" engaged in the different types of substance use/misuse. As such, each of these variables were recoded into three levels "none of my friends," "a few of my friends," and "some to all of my friends." The perceived risk and attitudes variables also violated the assumption of expected frequencies, as very few participants endorsed strong positive parental/peer attitudes towards prescription misuse, no risk to little risk of prescription misuse, or high degrees of acceptability of prescription misuse. As such, peer and parental attitudes towards prescription misuse were recoded into "very negative", "somewhat negative", and "neutral to somewhat positive." Perceived risk was recoded into "not risky to a little risky," "somewhat risky," and "very

risky." Perceived acceptability of prescription misuse was recoded into "not acceptable,"

"somewhat unacceptable," and neutral to very acceptable."

      ANOVA was used to examine the relationships between the continuous

psychosocial variables and misuse. Chi-square tests of independence were used to

examine the relationships between the categorical psychosocial variables and misuse.

These analyses demonstrated significant relationships between misuse and all

psychosocial variables (see Table 7).

Table 7

Frequencies and Percentages for Psychosocial Variables Stratified by Misuse

	Total Sample (n = 616)		No misuse (n = 470)		POM (n = 39)		PSM (n = 41)		PPM (n = 66)		*Test*	ES
	n	%	n	%	n	%	n	%	n	%		
PHQ-9	10.33 (7.13)		9.50 (7.09)		12.44 (6.60)		9.68 (6.37)		15.39 (5.81)		$F(3, 612)= 15.48***$	.07
GAD-7	9.13 (6.18)		8.46 (6.24)		11.46 (5.95)		9.41 (5.38)		12.35 (5.00)		$F(3, 612)= 10.10***$	.05
PSS	19.55 (6.01)		19.13 (6.01)		23.08 (5.01)		18.90 (5.92)		20.85 (5.80)		$F(3, 612)= 6.62***$	.03
Friends binge drinking											$X^2(6)=36.84***$	.16
None	223	36.2	193	41.1	10	25.6	9	22.0	11	16.7		
A few	226	36.7	175	37.2	15	38.5	13	31.7	23	34.8		
Some to all	167	27.1	103	21.7	14	35.9	19	46.3	32	48.5		
Friends illicit drug use											$X^2(6)=77.36***$	.24
None	187	30.4	173	36.8	4	10.3	6	14.6	4	6.1		
A few	229	37.2	179	38.1	19	48.7	17	41.5	14	21.2		
Some to all	200	32.5	118	25.1	16	41.0	18	43.9	48	72.7		
Friends prescription misuse											$X^2(6)=186.38***$	.38
None	422	68.5	371	78.9	17	43.6	17	41.5	17	25.8		
A few	128	20.8	81	17.2	17	43.6	16	39.0	14	21.2		
Some to all	66	10.7	18	3.8	5	12.8	8	19.5	35	53.0		
Risky[a]											$X^2(6)=47.15***$	.18
Not to a little risky	115	18.7	81	17.2	9	23.1	7	17.1	18	27.3		
Somewhat risky	99	16.1	53	11.3	10	25.6	12	29.3	24	36.4		
Very risky	402	65.3	336	71.5	20	51.3	22	53.7	24	36.4		

	Total Sample (n = 616)		No misuse (n = 470)		POM (n = 39)		PSM (n = 41)		PPM (n = 66)		Test	ES
	n	%	n	%	n	%	n	%	n	%		
Peer attitudes[b]											$X^2(6)=48.20$***	.19
Very negative	222	36.0	201	42.8	5	12.8	6	14.6	10	15.2		
Somewhat negative	159	25.8	121	25.7	11	28.2	11	26.8	16	24.2		
Neutral to very positive	235	38.1	148	31.5	23	59.0	24	58.5	40	60.6		
Parent attitudes[c]											$X^2(6)=57.61$***	.20
Very negative	431	70.0	356	75.7	22	56.4	28	68.3	25	37.9		
Somewhat negative	62	10.1	38	8.1	8	20.5	8	19.5	8	12.1		
Neutral to very positive	123	20.0	76	16.2	9	23.1	5	12.2	33	50.0		
Perceived acceptability											$X^2(6)=95.41$***	.27
Not acceptable	387	62.8	340	72.3	19	48.7	11	26.8	17	25.8		
Somewhat unacceptable	103	16.7	65	13.8	4	10.3	16	39.0	18	27.3		
Neutral- Acceptable	126	20.5	65	13.8	16	41.0	14	34.1	31	47.0		

[a] perceived risk of prescription misuse (physical, legal, or otherwise)
[b] perceived peer attitudes towards prescription misuse
[c] perceived parental attitudes towards prescription misuse
*** $p< .0001$

Objective #3 Multivariate Models of Misuse

The third research objective was to create multivariate models to optimize prediction of college students most at risk for each lifetime POM, PSM, and PPM. First random forest was used to identify important predictors of each of the three outcome variables (i.e., POM, PSM, and poly-prescription misuse). Each random forest model included 22 predictor variables representing sociodemographic, substance use, psychosocial factors. Variable importance scores were plotted and thresholds were set based on visual inspection. Variables with importance scores above the threshold were selected as important variables for each outcome variable. Then, regression analyses were conducted for each of the outcome variables using the identified most important predictors for that outcome variable. Because the lifetime misuse variables (lifetime POM, lifetime PSM, and lifetime PPM) are dichotomous variables (yes/no), logistic regression was the most suitable analysis to provide interpretable coefficients to the predictors in the model. Logistic regression requires a binomial distribution of scores for the dependent variable and does not assume linearity between the dependent and independent variables.

Prescription Opioid Misuse

Random forest identified PSM and illicit drug as the most important predictors of POM. As illustrated in Figure 3, there appeared to be a clear decrease in variable importance after tobacco use and another after GAD-7. As such, it was unclear whether or not to include GAD-7 in the final model. Per recommendations from Peng & So, 2002, alternative versions of the model were created, one including GAD-7 and one without, and the models were then compared based on goodness of fit, statistical significance of

each predictor, predictive power, and accuracy of prediction in order to determine the best-fit model.

Figure 3

Variable Importance Plot for Prediction of Prescription Opioid Misuse
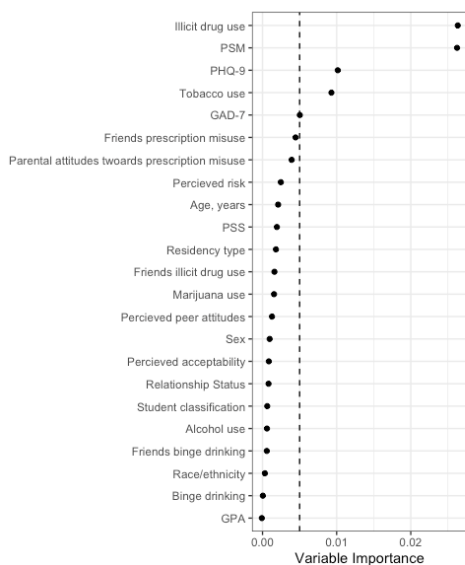
Ultimately, the final model for the outcome variable lifetime POM included four predictor variables: PSM, illicit drug use, PHQ-9 score, and tobacco use. A test of the full model versus an intercept only model was statistically significant, X^2 (5) = 231.77, $p <$ .0001. The sensitivity and specificity of this model were 58% and 96%, respectively. Overall prediction success was 90%. Logistic regression coefficients, z values, odds ratios, and confidence intervals for each predictor are outlined in Table 8.

Prescription Stimulant Misuse

Random forest identified POM, illicit drug, and amount of friends who misuse prescription medication as the most important predictors of PSM. As shown in Figure 4, beyond this, perceived acceptability was the next important predictor before a notable

decline in variable importance. As such models with and without perceived acceptability were created. Models were then compared based on goodness of fit, statistical significance of each predictor, predictive power, and accuracy of prediction in order to determine the best-fit model.

Figure 4

Variable Importance Plot for Prediction of Prescription Stimulant Misuse

The final model consisted of four variables: POM, illicit drug use, amount of friends who misuse prescription medication, and perceived acceptability of prescription misuse. A test of the full model versus an intercept only model was statistically significant, X^2 (7) = 229.35, $p < .0001$. The sensitivity and specificity of this model were 58% and 96%, respectively. Overall prediction success was 89%. Logistic regression coefficients, z values, odds ratios, and confidence intervals for each predictor are outlined in table 8.
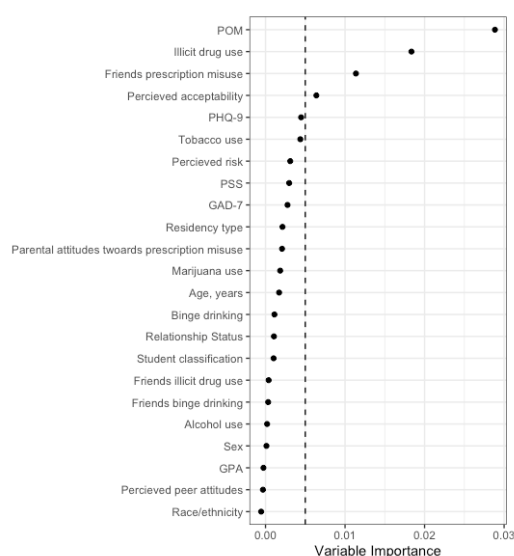
Poly-Prescription Misuse

For the outcome variable lifetime PPM, illicit drug use was the identified most important predictor, followed by amount of friends who misuse prescription medication, and tobacco use. As demonstrated in the figure 5, there was a decline in variable importance after tobacco use, and another clear decline in variable importance after GAD-7. As such, the three predictor variables before the first decline (i.e., illicit drug use, amount of friends who use misuse prescription medication, and tobacco use) were included in one model and alternative models were fit including predictor variables that fell above the second decline in variable performance (i.e., illicit drug use, amount of friends who misuse prescription medication, tobacco use, perceived acceptability, perceived risk ,marijuana use, and GAD-7). Models were then compared based on goodness of fit, statistical significance of each predictor, predictive power, and accuracy of prediction in order to determine the best-fit model.

Figure 5

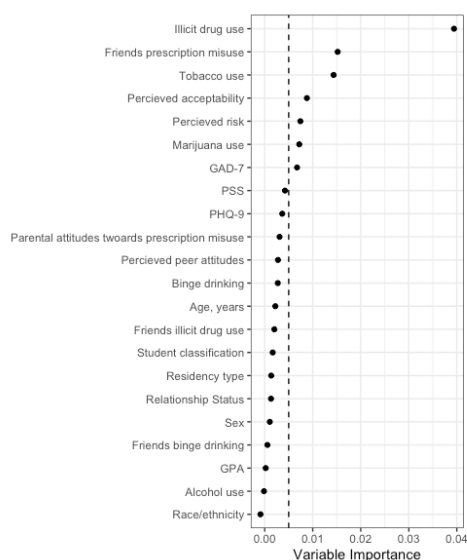*Variable Importance Plot for Prediction of Poly-Prescription Misuse*

The final model consisted of five predictors: endorsement of illicit drug use, amount of friends who misuse prescription medication, tobacco use, marijuana use, and perceived risk. For the outcome variable lifetime PSM, a test of the final full model versus an intercept only model was statistically significant, $X^2 (10) = 259.39$, $p < .0001$. The sensitivity and specificity of this model were 61% and 93%, respectively. Overall prediction success was 85%. Logistic regression coefficients, z values, odds ratios, and confidence intervals for each predictor are outlined in Table 8.

Table 8

Summary of Predictors for Prescription Opioid Misuse, Prescription Stimulant Misuse, and Poly-Prescription Misuse

Outcome Variable	Predictor Variables	b Est	(SE)	OR Est	95% CI	z	Sig
POM	Intercept	-3.47	(0.27)	**0.03**	[0.02, 0.05]	-12.90	<.001 ***
	PSM, *yes vs. no*	1.96	(0.31)	**7.10**	[3.90-13.01]	6.39	<.001 ***
	Illicit Drug Use, *yes vs. no*	1.67	(0.32)	**5.29**	[2.82, 9.98]	5.18	<.001 ***
	Depression, *PHQ-9[a]*	0.06	(0.03)	**1.06**	[1.02, 1.11]	1.89	<.01 **
	Tobacco Use	1.21	(0.33)	**3.35**	[1.76- 6.46]	3.66	<.001 ***
PSM	Intercept	-3.45	(0.26)	**0.03**	[0.02, 0.05]	-13.10	<.001 ***
	POM, *yes vs. no*	1.91	(0.33)	**6.76**	[3.55, 12.96]	5.81	<.001 ***
	Illicit Drug Use, *yes vs. no*	1.59	(0.32)	**4.88**	[2.59, 9.20]	4.91	<.001 ***
	Friends, *some-all vs. none-few*	1.50	(0.39)	**4.49**	[2.10, 9.73]	3.85	<.001 ***
	Perceived Acceptability of Rx Misuse[b]						
	Somewhat unacceptable	1.67	(0.35)	**5.33**	[2.72, 10.58]	4.85	<.001 ***
	Neither unacceptable or acceptable	0.23	(0.45)	1.26	[0.51, 2.98]	0.51	.607
	Somewhat acceptable	1.51	(0.53)	**4.54**	[1.60, 12.66]	2.88	.004 ***
	Very acceptable	0.26	(0.85)	1.29	[0.24, 6.67]	0.30	.759
PPM	Intercept	-2.29	(0.26)	**0.10**	[0.06, 0.17]	-8.73	<.001 ***
	Illicit Drug Use, *yes vs. no*	1.92	(0.30)	**6.81**	[3.84, 12.25]	6.50	<.001 ***
	Friends, *some-all vs. none-few*	1.60	(0.37)	**4.94**	[2.40, 10.44]	4.27	<.001 ***
	Tobacco use, *yes vs. no*	0.87	(0.28)	**2.38**	[1.36, 4.17]	3.05	< .01 **
	Marijuana use, *yes vs. no*	0.93	(0.29)	**2.53**	[1.43, 4.52]	3.18	< .01 **
	Perceived Risk, *none-somewhat vs. very risky*	-.94	(0.25)	**0.39**	[0.24, 0.64]	-3.75	<.001 ***

Note: PHQ-9 = Patient Health Questionnaire, Friends = friends endorsing any misuse of any medication.

[a] PHQ-9 is grand mean centered at 10.33

[b] Reference category is *Very unacceptable*

** *p* < 0.01, *** *p* < 0.001.

Discussion for Study #1

The goal of the present study was to identify similarities and differences in correlates and predictors of PSM and POM in undergraduate college students. This purpose was realized through three main objectives: (1) To describe POM and PSM within the sample of undergraduate college students in terms of prevalence, frequency, and types of medications misused, (2) To examine sociodemographic, substance use, and psychosocial correlates of POM, PSM, and PPM, and (3) To build multivariate models of POM, PSM, and PPM that optimize prediction of undergraduate students most at risk for misuse.

Prevalence of Prescription Opioid and Prescription Stimulant Misuse

Of the 616 undergraduate college student participants in the present study, 17.0% reported misusing prescription opioids at least once in their lifetime, 8.8% endorsed past year misuse, and 1.5% endorsed past 30-day misuse. These rates are congruent with prior literature (Brandt et al., 2014; McCabe et al., 2005; Sanders et al., 2014; Weyandt et al., 2022). In the present study 17.4% of participants endorsed misusing prescription stimulants at least once in their lifetime, 8.3% endorsed past year misuse, and 1.9% endorsed past 30-day misuse. These rates are also congruent with existing literature (Benson et al., 2015; Kaloyanides et al., 2007; Weyandt et al., 2009).

Sociodemographic Correlates

Bivariate analyses demonstrated that the sociodemographic variables sex, residency type, and age were significantly related to misuse of prescription medication. In

the context of sex, previous literature suggests that males may be more likely to misuse prescription opioids and prescription stimulants (Benson et al., 2015; Weyandt et al., 2022). However, in the present study, the sample is heavily unbalanced such that the sample is 87% female and thus findings related to sex must be interpreted cautiously.

The present study determined a significant relationship between residency type and misuse. Participants who endorsed PPM were least likely to live at their parent or guardian's home and most likely to live in campus affiliated housing, as compared to non-misusers, participants who endorsed POM only, or those who endorsed PSM only. For the purpose of bivariate analyses, fraternity and sorority housing was collapsed with "on-campus/residence hall" into the "campus affiliated housing" category in order to meet the assumption of expected frequency for chi-square tests of independence. However, of note, those who endorsed PPM were the most likely to live in fraternity or sorority housing (24.2%) as compared to 5.5% of those who denied misuse of any prescription, 2.6% of those who endorsed POM only, and 7.3% of those who endorsed PSM only. Although this was not able to be further investigated in the present study due to relatively low frequency ($n = 46$) of those indicating they live in fraternity or sorority housing, previous literature suggests higher rates of POM and PSM in students living in fraternity/sorority housing (McCabe et al., 2005; Kenne et al., 2017, Watkins 2016).

The present study found that age was related to misuse such that those who denied any type of prescription misuse tended to be younger on average (m = 21.5, SD = 5.03), whereas those endorsing POM only had the highest average age (m = 23.72, SD = 7.33). This finding lends support to an observed trend in which rates of heavy alcohol and other substance use tend to decline in older college students, around age 24, while rates

of POM have been observed to remain consistent among younger and older college students (Holt et al., 2023; McCabe et al., 2005). Notably, recent research has found that PSM tends to decline over time among college students, with the majority of those who indicated college PSM ceasing misuse by two years post-graduation (Holt et al., 2023). This may suggest that POM poses a unique risk, as students may not "age out" of POM in the same way as with other types of substance use/misuse.

Despite significant bivariate relationships between misuse and the sociodemographic variables sex, residency, type, and age, none of these variables were determined by random forest analyses to be important predictors for any of the three outcome variables, lifetime POM, lifetime PSM, or lifetime PPM and thus were not included in any of the final models.

Substance Use Correlates

All substance use variables were determined to be significantly associated with misuse. This is unsurprising, as previous literature has demonstrated a strong relationship between different types of substance use/misuse. Consistent with previous research, the present study found tobacco use to be significantly related to misuse (McCabe et al., 2005; Papazisis et al., 2018; Sepúlveda et al., 2011; Zale et al., 2014). Only 24% of those who denied any lifetime prescription misuse endorsed tobacco use, as compared to 86.4% of those who endorsed PPM, 71.8% of those who endorsed POM only, and 53.7% of those who endorsed PSM only. Random forest analyses determined tobacco use to be an important predictor for POM and PPM, but not PSM. According to the final logistic regression models, participants who endorsed tobacco use were more than three times as

likely to endorse POM and more than twice as likely to endorse PPM. Alcohol and past 30-day binge drinking were found to be associated with misuse in bivariate analyses, but were not determined by random forest analyses to be important predictors of any of the three outcome misuse variables and thus were not included in any of the final models.

Consistent with prior literature, marijuana was found to be associated with prescription misuse (McCabe et al., 2005; Sepúlveda et al., 2011, Teter et al., 2006). In the present study, only 35.3% of participants who denied prescription misuse endorsed marijuana use, as compared to 87.9% of those who endorsed PPM, 79.5% of those who endorsed POM only, and 73.2% of those who endorsed PSM only. Although high proportions of respondents endorsing prescription misuse also endorsed marijuana use, relative to those who denied prescription misuse, random forest analyses only determined marijuana use to be an important predictor of PPM. According to the final regression model, those endorsing marijuana use were more than two and a half times more likely to engage in PPM.

In the present study, those who engaged in illicit drug use, other than marijuana, were more than five times more likely to engage in POM, almost five times more likely to engage in PSM, and almost seven times more likely to engage in PPM than those who do not engage in illicit drug use. This is aligned with previous research that has identified illicit drug use as a significant predictor of prescription misuse for both opioids and stimulants (Arria & Dupont, 2010; McCabe et al., 2005; McCabe et al., 2013).

Just as illicit drug use was identified as an important predictor of the outcome misuse variables, so too were other types of prescription misuse. That is, those who endorsed POM were about seven times as likely to endorse PSM, and vice versa. This

suggests that while there may be differences in predictors of prescription opioid and stimulant misuse, it is clear that engagement in one type of prescription misuse is one of the largest predictors of the other.

Psychosocial Correlates

Consistent with previous literature all psychosocial variables, including depression, anxiety, perceived stress, peer substance use behaviors, perceived risk of prescription misuse, perceived peer and parental attitudes towards prescription misuse, and perceived acceptability of prescription misuse were all significantly related to prescription misuse (Benson et al., 2015; De Bruyn et al., 2019; Ford & Ong, 2014; Harries et al., 2018; Maahs et al., 2016; Murray, 2020; Ne'Eman-Haviv & Bonny-Noach, 2019; Schepis et al., 2020; Watkins, 2016; Weyandt et al., 2022). Despite these bivariate associations with misuse, only depression, amount of friends engaging in prescription misuse, perceived risk of prescription misuse, and perceived acceptability of prescription misuse were determined to be important predictors of any type of misuse and thus were included in the final models.

PHQ-9 score was only determined to be an important predictor for POM and not PSM or PPM, and thus was included in the final model predicting POM. This may be explained by previous findings on motives for misuse which found relief of emotional pain to be among commonly reported motives for POM in college students (McCabe et al., 2007), whereas commonly reported motives for PSM are primarily related to enhanced studying, concentration, and alertness (Kenne et al., 2017).

The present study found amount of friends who misuse prescription medication to be a significant predictor of both PPM and PSM, but not POM. Indicating that some to all of their friends misuse prescription medication (of any class of prescription) was found to increase the odds of endorsing PSM by more than four and the odds of endorsing PPM by almost five. Further, findings from the present study suggest perception of risk and acceptability of misuse of prescription medication are also significantly predictive of different types of misuse. Those who endorsed PPM had the lowest proportion of participants that indicated high perceived risk (physically, legally, or otherwise) of prescription misuse (36.4%), as compared to those who denied prescription misuse (71.5%), those who endorsed POM only (51.3%), and those who endorsed PSM only (53.7%). As such, perceived risk was determined to be a significant predictor of PPM, but not POM or PSM. Unsurprisingly, those who denied prescription misuse had substantially lower proportions of participants that indicated that prescription misuse was neutral to acceptable (13.8%), as compared to those who endorsed PPM (47.0%), those who endorsed POM only (41.0%), and those who endorsed PSM only (34.1%). Perceived acceptability of prescription misuse was a significant predictor of PSM such that those who indicated that prescription misuse was "somewhat unacceptable" had more than five times the odds of endorsing PSM, as compared to those who indicated prescription stimulant misuse was "very unacceptable." Those who indicated prescription misuse was "somewhat acceptable" had four and a half times the odds of endorsing PSM as compared to those who indicated prescription stimulant misuse was "very unacceptable." Interestingly, indicating that PSM was "very acceptable" was not a significant predictor of PSM. This is likely due to the fact that only one participant who endorsed PSM

indicated that prescription misuse is "very acceptable." The differential relationships between the three types of misuse measured and psychosocial variables is interesting, as it may reflect variations in social perceptions of each type of misuse. For example, having friends that engage in prescription misuse was found to be significantly predictive of PSM and PPM, but not POM. This may suggest that those engaging PSM and PPM are more likely to be open about their misuse with peers, misuse with their peers, or obtain prescriptions from their peers, as compared to those who engage in POM. Additionally, perceived risk and perceived acceptability were found to be significant predictors of PSM and PPM, respectively, but not POM. Taken together, this may suggest a relationship between association with those engage in prescription misuse and social perception of misuse, in the context of risk and acceptability of misuse. These findings suggest the need for more research into the variable influence of social factors on different types of misuse.

Implications and Limitations

Given the association between college prescription misuse and increased risk of physical, mental health, legal, and academic consequences, the present research focused on gaining a better understanding of the factors associated with different types of misuse and addressed important gaps in the literature. First, while many studies have sought to identify correlates of POM, PSM, or general prescription misuse, few studies have assessed for similarities and differences in correlates of POM and PSM simultaneously in the same study. The present study addresses this gap in the literature by assessing for distinct classes of prescription misuse (i.e., opioids and stimulants) thus allowing for

direct comparison of correlates of each type of misuse. Second, few existing studies differentiate between misuse of a single class of prescription medication versus poly-prescription misuse. The present study is the first known study to identify and compare predictors of single prescription class versus poly-prescription misuse in college students. In doing so, the present study demonstrated important differences in predictors of each type of misuse that should likely be considered when designing prevention and intervention efforts to best target those at risk for each type of misuse. It may be particularly important to target those at risk for PPM, as PPM is associated with increased risk of SUD as compared to misuse of a single class of prescription. Finally, the present study utilized a novel approach to variable selection that addresses many of the shortcomings of traditionally used methodology in this area of research. The two-step random forest and logistic regression approach to model building used in the present study optimized variable selection to maximize model fit.

There are, however, limitations in the current study. First, the sample in the present study was primarily female (87%). In 2017, two years prior to data collection for the present study, 56.7% of undergraduates enrolled in college were female (U.S. Department of Education, 2017). Because the proportion of female students in the study is substantially higher than the proportion of female undergraduates nationally, this bias in the present study may limit generalizability. Second, the present study was limited to an investigation into correlates and predictors of those who indicated POM, PSM, or PPM at least once in their lifetime due to having only a small percentage of the sample indicate more recent and/or more frequent misuse. Future studies may focus specifically on students endorsing past year and past 30-day prescription misuse, and those who

endorse more frequency of misuse. And lastly, the present study was cross-sectional and analyzed self-report data. As such, we are unable to make causal inferences about the relationships between predictors and outcomes. Further, there are inherent limitations when using self-report data as it is susceptible to various biases such as social desirability.

CHAPTER III

STUDY #2: PERCEIVED RISK, MOTIVES, AND SOURCE OF MISUSED

MEDICATION FOR PRESCRIPTION STIMULANT AND OPIOID MISUSE

AMONG COLLEGE STUDENTS

Young adults, aged 18-25, have the highest prevalence of prescription medication misuse of any age group (SAMHSA, 2020). Within this age group, research suggests prescription stimulant misuse (PSM), is higher in college students than in their non-student peers (Schulenberg et al., 2019). Rates of prescription opioid misuse (POM) have been found to be similar among college students and their non-student peers (Schulenberg et al., 2019). Prevalence rates for prescription misuse on college campuses in the United States vary, but have been estimated to be as high as 17% for stimulants and 20% for opioids (Benson et al., 2015; Weyandt et al., 2022). Widespread substance use and misuse in college students may be, in part, attributed to the unique demands and environment of college. Academic stress, separation from familiar social supports, increased independence, and increased access to drugs and alcohol put college students at high risk for substance use (McCabe et al., 2006; Schulenberg & Maggs, 2002; Zullig & Divin, 2012). Perceived risk and acceptability of use/misuse among peers may also contribute to the increased risk of substance use in college students (Johnston et al., 2015). Despite some   research that suggests lower perception of harm of prescription medication misuse than illicit drugs, prescription medication misuse is associated with negative physical health, mental health, legal, and academic consequences (CDC, 2015; Iloabuchi et al., 2021; McCabe et al., 2009; NIDA, 2018b; Zullig & Divin 2012).

Perception of Risk

Previous research has established that perceived low risk of harm predicts increased likelihood of substance use (Johnston et al., 2015). This relationship has been well established for alcohol and marijuana use, however, less research has been done to establish this relationship relative to prescription medication misuse in college students. There is, however, some evidence that supports this relationship between perceived risk and prescription medication misuse in college students (Blevins et al., 2017; Brandt et al., 2014; Kenne et al., 2017). In one study of 199 college students at a four-year university in West Virginia, Blevins and colleagues (2017) found that those who endorsed past 60-day PSM had a lowered perception of risk than those who did not endorse misuse. Interestingly, another study found that while low risk perception may be associated with increased prescription medication misuse, the opposite may also be true-high risk perception is associated with abstinence from substance misuse (Brandt et al., 2014). In a survey of 313 college students at a Northeastern university, Brandt and colleagues found that when non-misusers were asked why they chose to abstain from prescription misuse, 61% reported it was due to a fear of physical health consequences and 60% reported that it was due to fear of mental health consequences (2014). Similarly, Kenne and colleagues found that in a study of 668 college students at a Midwestern university, non-misusers reported significantly higher risk of harm of the prescription opioid medication, Vicodin, than misusers (2017). Conversely, a recent study of 1345 college students from a liberal arts college found no relationship between risk perception and endorsement of past year prescription medication misuse (Kollath-Cattano et al., 2020).

Motives for Misuse

Previous research has revealed a variety of motives for prescription misuse in college students. Common motives for prescription misuse vary by the type of medication misused and often seem to reflect the intended purpose of the medication. For instance, Blevins and colleagues (2017) found that among 86 college students who endorsed PSM in the past 60 days, the most common motive for misuse was related to academic performance (e.g., to improve my grades, to help me focus, to help with concentration, to help me to stay up later to study, etc.). Similarly, in another study of 382 students who endorsed lifetime PSM, Teter and colleagues (2006) found that the most common motives for misuse were "because it helps me concentrate" (65.2%), "because it helps me study" (59.8%), and "because it helps increase my alertness" (47.5%). Other, less commonly endorsed motives included weight loss, experimentation, and to get high (Teter et al., 2006).

In the context of prescription opioids, McCabe and colleagues (2007) found that in a sample of 640 college students who indicated lifetime POM, physical pain relief was the most common motive for misuse (63%). Similarly, Weyandt and colleagues (2022) found that in a study of 278 college students from two universities in the United States 63.7% indicated relief of physical pain as the primary motive for POM. However, in another study of 527 students at four-year universities in the United States who endorsed lifetime POM, the most commonly reported motives for misuse were to relax (72%), to get high (65%), and to have fun (65%; Lord et al., 2011). Interestingly, in this study, only 19% of misusers indicated misuse for the purpose of managing chronic pain (Lord et al., 2011).

Some evidence suggests that the risk of different adverse consequences of misuse vary by motive for misuse (Boyd et al., 2009; McCabe et al., 2009). More specifically, one study of 912 high school students in a midwestern school district found that those that misused prescription drugs for "sensation seeking" purposes, including "to get high" or "to experiment," were more likely to engage in other problem behaviors such as gambling, illicit drug use, and binge-drinking (Boyd et al., 2009). Another study of over 12,000 adolescents across the United States echoed these results and found that those who engaged in POM only for pain relief had significantly lower rates of other substance use behaviors than those who misused for other purposes (e.g., to get high, to relax; McCabe et al., 2009). This association between motive and other risky behaviors and negative consequences has also been found among college students. For instance, a study of 86 college students revealed that PSM for enhancement (e.g., to get high), social, weight loss and expansion (e.g., to expand my awareness) reasons was associated with greater risk of negative consequences than those who misuse for reasons related to academic performance (Blevins et al., 2017). Further, in this study those who misused for weight loss reasons misused more frequently than those who misused for any other reason (Blevins et al., 2017). In a study of 4580 college students, McCabe and colleagues (2007) found that those who engaged in POM for pain relief were no more likely than their peers who did not report misuse to experience three or more drug related problems in the past year. However, students who engaged in POM for reasons other than pain relief were fifteen times more likely to experience three or more drug related problems in the past year (AOR = 15.1, 95% CI = 11.5–19.9; $p < 0.001$).

Source of Misused Medication

While there is some heterogeneity in the sources of prescription medications misused by adolescents and young adults, research has found the leading source to be friends/peers (McCabe et al., 2019; McCabe et al., 2007). Interestingly, some research in adolescents has found gender differences in source of misuse such that men are more likely to report sources involving friends or purchasing from dealers, whereas women are more likely to report obtaining prescription medication from family members or using their own leftover prescription medication (McCabe et al., 2007; McCabe et al., 2013; McCabe et al., 2019). There has been limited research examining the relationship of source of misused prescription medication with motives for misuse. That is, it is unclear whether those who misuse for purposes of physical pain relief are more likely to obtain their prescriptions from a specific source (e.g., leftover from a prescription). A recent study found that among 1917 high school seniors that reported past-year prescription misuse, there was some evidence of a relationship between source and motive for misuse (McCabe et al., 2019). In this study, approximately 27% of adolescents who misused their own leftover prescription endorsed self-treatment motives (McCabe et al., 2019). This area calls for more attention, as this information has important implications for efforts to stop diversion, and could be used to help inform prescribing practices and prevention efforts.

Conclusions from the Literature

Given the concerning rates of POM and PSM among 18-25 year-olds nationally, the consequences of misuse, and increased risk factors unique to the college student

population, it is important to gain a better understanding of the perceived risk of misuse, motivations for misuse, and source of misuse. Previous research has established that low perceived risk of harm predicts increased likelihood of substance use (Johnston et al., 2015). If this relationship holds true for prescription medication misuse, it may provide a target for prevention efforts. Given the lack of research and consensus in this area, more work needs to be done to better understand this relationship. Further, previous literature has suggested that recreational motives for prescription medication misuse may be associated with greater likelihood of substance-related consequences (McCabe et al., 2007). However, there has been limited research on the relationship between motives for misuse and source of misused prescription medication. As such, more research in this area is needed, as this information may have important implications for prescribing practices and the development and implementation of prevention efforts.

Research Purpose and Study Objectives

The primary purpose of present study was to explore perceived risk of prescription misuse and factors related to initial misuse of prescription stimulants and opioids. This purpose was realized through the following research objectives:

1) To describe the perceived risk, initial motives for misuse, and initial source of misuse of prescription stimulants and prescription opioids in the sample of college students

2) To examine the relationship between perceived risk of prescription medication misuse and lifetime misuse of prescription stimulants and prescription opioids among college students

3) To examine the relationship between initial motive for misuse and initial source of prescription medication misused among college students for prescription stimulants and prescription opioids

Methods

Participants

Participants were drawn from an extant dataset from a previous study that employed a web-based survey, designed to assess substance use behaviors, predictors, motives, perceived risk and perceived peer attitudes towards prescription misuse among a national sample of undergraduate students. The previous study collected data from 616 undergraduate students enrolled full-time (i.e., enrolled at least twelve credits) at four-year universities in the United States of America who were at least 18 years of age. The present study primarily utilized the data from the 146 participants who endorsed lifetime PSM and/or POM. For the second research objective, to examine the relationship between perceived risk of prescription medication misuse and lifetime misuse, data from all 616 participants was analyzed.

Procedure

Survey respondents were obtained via Qualtrics Panel which uses traditional actively managed market research panels in order to aggregate samples that meet the inclusion and exclusion criteria provided by the researcher. Prospective participants whose Qualtrics profiles aligned with the inclusion/exclusion criteria were invited via

email to take part in the survey. Inclusion criteria included being at least 18 years of age and enrolled full time (e.g., at least 12 credits) at a four-year university in the United States of America. Participants who met the criteria and completed the survey were incentivized in a variety of forms (e.g., airline miles, gift cards, vouchers) based on the length of survey, their specific panelist profile, and difficulty of sample acquisition for the survey. Meta-analyses comparing the internal reliability estimates and effect sizes from online panel data, such as Qualtrics panel, to estimates from conventionally sourced data lend support for the validity of this type of data collection, as they have found the two types of data to have similar psychometrics properties (Walter et al., 2018).

In order protect the anonymity of survey respondents, respondents who met inclusion criteria to participate in the study were provided an electronic letter of information and were to mark it as "read" prior to survey completion (see Appendix A). In order to reduce aspects of respondent burden, including survey completion time, length of survey, and increase ease of navigation, this survey used conditional branching. Conditional branching is a survey technique that helps respondents navigate surveys by leading them to the next appropriate question and automatically by-passing items that are not applicable to them and has been found to reduce some aspects of respondent burden that can negatively impact data quality (Briz-Redón, 2021; Galesic & Bosnjak, 2009; Norman & Pleskac, 2002; Sharp & Frankel, 1983).

Data were collected in June 2019. After data collection, validity checks (e.g., fast responses, patterned responses and inconsistent responses between endorsement of misuse and frequency of misuse for outcome variables POM and PSM) were conducted

and respondents who failed at least one validity check were removed from analysis

(*n*=59). This left a total of 616 survey completers.

Data and Instrumentation

The measures described below were chosen to gather information relevant to

substance use behaviors, motives, source, and perceived risk. Table 9 summarizes the

study variables included in this study. The survey was administered through Qualtrics

Survey Research Suite, a web-based tool available for use through Utah State University.

The survey in its entirety is located in Appendix A.

Demographics Information

A demographic questionnaire was used to collect demographic information,

including biological sex, relationship status, ethnic identity, college year, and residency

type.

Prescription Misuse

Lifetime PSM and POM were assessed by presenting respondents with a list of

the most common names of opioid and stimulant medications, acquired from the National

Institute on Drug Abuse, and two items asking the respondents to indicate which

medication had ever been misused and how often the medication has been misused.

Misuse was defined for the respondents as "taking medicine in a way or dose other than

prescribed, taking someone else's prescription, or taking medicine for the effect it causes

or to get high" (NIDA, 2018). The response scale is (1) never used; (2) used, but not in

the past 12 months; (3) used, but not in the past 30 days; and (4) used in the past 30 days.

Perceived Risk

Perceived risk of prescription medication misuse was assessed with one item adapted from previous research on predictors of prescription medication misuse in college students (Watkins, 2016). This item asked respondents about the perceived risk students face when misusing prescription medication (physically, legally, or otherwise), with responses ranging from (1) not risky to (4) very risky.

Initial Motives for Misuse

Primary motive for misuse was assessed in respondents who endorse PSM/POM. Motive was assessed with one item for each type of prescription medication misused. Respondents were asked to indicate the primary motive for their first time engaging in PSM/POM. Response options for these two items were based on prior research on motives for prescription misuse in college students (Kenne et al., 2017; Teter et al., 2006).

Initial Source of Misused Medication

Source of misused medication for each class of medication misused was assessed with one item in which respondents are asked to indicate where they obtained the medication the first time they misused. Response items include a) from a doctor's prescription, b) leftover from an old prescription, c) wrote a fake prescription, d) stole from a doctor's office/clinic/pharmacy, e) got from a friend or relative for free, f) bought from a friend or relative, g) took from a friend or relative without asking, h) bought from a drug dealer or stranger, i) bought from the internet, or j) other. These response items were adapted from previous research on source of diversion in prescription misuse (Ford & Lacerenza, 2011).

Analytic Plan

The first research objective was to describe perceived risk, initial motives for misuse, and initial source of misused medication for prescription stimulants and prescription opioids among college students. In order to address this research objective, descriptive statistics including frequencies, percentages, mean, and standard deviation were calculated. The second research objective was to examine the relationship between perceived risk of prescription medication misuse and lifetime misuse of prescription stimulants and prescription opioids. In order to address this research objective, chi-square tests of independence were performed to assess for differences in perceived risk between respondents who endorsed lifetime prescription stimulant and/or lifetime prescription opioid misuse and those who reported never misusing. The third research objective was to examine the relationship between initial motives for POM and PSM and initial source of medication misused. In order to address this research objective, chi-square tests of independence were performed to examine the relationships between the categorical variables motives for misuse and initial source of misused prescription medication.

Table 9

Summary of Study Variables

Variables	Method of assessment
Demographic Variables	
Age	Age in years
Sex	Sex assigned at birth: male, female
Relationship Status	Single, married, separated/divorced/widowed, In a committed relationship
Race/Ethnicity	American Indian/Alaskan Native, Asian, Black/African American, Hispanic/Latinx, Native Hawaiian/Pacific Islander, White, Other
Residency Type	Living arrangement: on campus housing, living in fraternity/sorority house, parent/guardian's home, other off campus housing
Student Classification	Freshman, sophomore, junior, senior
Prescription Misuse	
Prescription Opioid Misuse	Prescription opioid misuse, initial source, and motives
Prescription Stimulant Misuse	Prescription stimulant misuse, initial source, and motives
Perceived risk	Perceived risk: not risky to very risky

Results

Survey data were collected in June 2019. All analyses were performed in *R* (R Core Team, 2021). Table 10 presents a summary of all demographic characteristics for the sample (n=616). Of the 616 survey respondents, ages ranged from 18 to 63 and the median age was 20. The majority identified as single (62%), female (87%), non-White (54%), and lived outside of their parents'/guardians' home (63.5%).

Table 10

Mean, Standard Deviation, Frequencies, and Percentages for Demographics

	n	%	M *(SD)*
Age			21.80 (5.45)
Sex assigned at birth			
Female	536	87	
Male	80	13	
Race/ethnicity			
American Indian or Alaskan Native	20	3.2	
Asian	50	8.1	
Black or African American	149	24.2	
Hispanic or Latinx	109	17.7	
Native Hawaiian or Pacific Islander	5	.8	
White	274	44.5	
Other	9	1.5	
Relationship status			
Single (not involved)	382	62	
In a committed romantic relationship	192	31.2	
Married	37	6	
Divorced	4	.6	
Separated	1	.2	
Residency type			
Residence hall/on-campus housing	191	31	
Fraternity/Sorority House	46	7.5	
Parent/guardian's home	225	36.5	
Other off-campus housing	154	25	
College year			
Freshman	151	24.5	
Sophomore	185	30	
Junior	152	24.7	
Senior	128	20.8	

Objective #1: Describe Perceived Risk, Initial Motives for Misuse and

Initial Source of Misused Medication

The first study objective was to describe perceived risk, initial motives for misuse, and initial source of medication misused for PSM and POM in the sample of undergraduate college students. The majority of participants (65.3%) indicated that they found misusing prescription medication to be very risky (physically, legally, or otherwise), as compared to only 10% of participants who indicated that they did not find prescription misuse to be risky at all.

One hundred and seven participants (17.4%) endorsed that they had engaged in PSM at least once in their lifetime. Among those who indicated lifetime PSM, the most commonly reported motives for first time misuse of prescription stimulant medication was "to help me study" (32.7%) followed by "to get high" (20.6%). Initial motives for PSM and POM are presented in Figures 6 and 7, respectively. Seventeen percent of participants endorsed that they had engaged in POM at least once in their lifetime. Among the 105 participants who indicated lifetime POM, the most commonly reported motive for first time misuse of prescription opioid medication was to relieve emotional pain (35.2%), followed by to relieve physical pain (29.5%).

Of those who indicated lifetime POM and PSM, the majority obtained the first medication they misused from a friend or relative for free (26.7% and 29.0%, respectively). Frequencies and percentages for initial source of misused medication for POM and PSM are included in Table 11.

Figure 6

Initial Motives for PSM
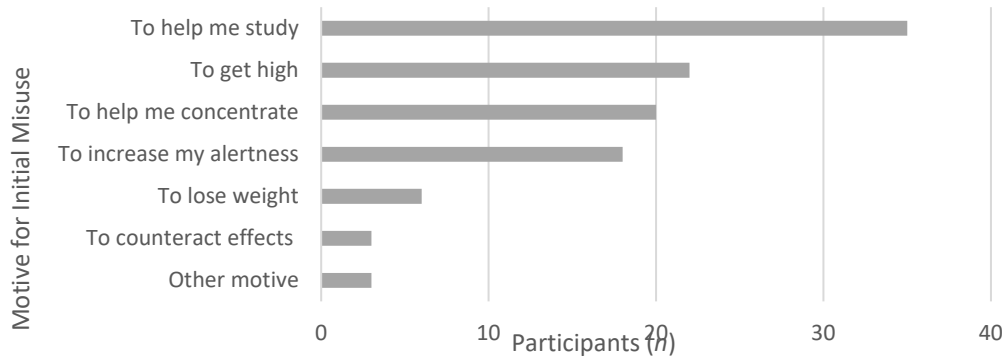
Note. "To counteract effects" = To counteract the effects of other drugs

Figure 7

Initial Motives for POM
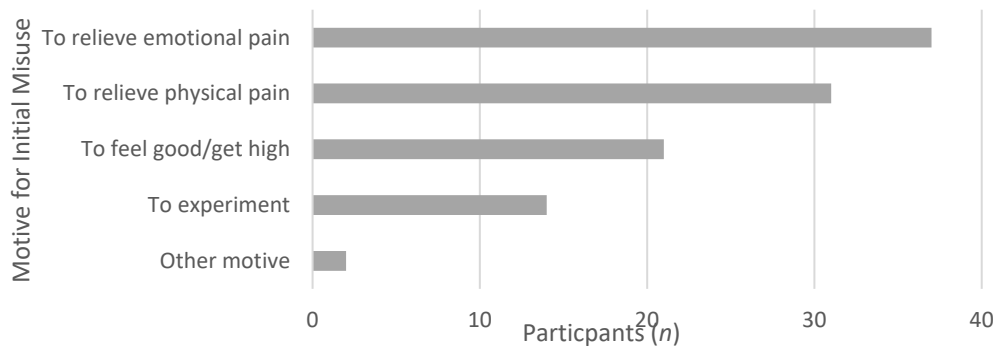
Table 11

Initial Source of Medication Misused

	PSM (*n* = 107)		POM (*n* = 105)	
Initial Source of Misused Medication	*n*	%	*n*	%
From a doctor's prescription	20	18.7	19	18.1
Leftover from an old prescription I obtained legally	16	15.0	19	18.1
Wrote a fake prescription	7	6.5	5	4.8
Stole from a doctor's office/clinic/pharmacy	7	6.5	2	1.9
Got from a friend/relative for free	31	29.0	28	26.7
Bought from a friend/relative	15	14.0	7	6.7
Took from a friend/relative without asking	4	3.7	17	16.2
Bought from a drug dealer or stranger	6	5.6	5	4.8
Bought from the internet	1	0.9	1	1.0
Other	0	0.0	1	1.0

Objective #2: Perceived Risk and POM/PSM

The second study objective was to examine the relationships between perceived risk of prescription misuse and the outcome variables lifetime PSM and lifetime POM among undergraduate college students. Chi-square tests of independence were conducted in order to examine this relationship. Cramer's V was calculated to determine the strength of the association. Chi-square tests of independence assume mutually exclusive and exhaustive categories, independent observations, and that no more than 20% of the cells have expected frequencies less than five. These assumptions were met for both associations tested.

Chi-square statistics demonstrated a significant relationship between perceived risk and misuse for both prescription stimulants, X^2 (3, n=616) = 49.08, $p < .001$, and prescription opioids, X^2 (3, n=616) = 51.99, $p < .001$. The effect sizes for these finding were small (Cramer's V = .28 and .29, respectively). About 43% of those who engaged in

lifetime PSM endorsed that prescription misuse was "very risky," as compared to 70% of non-misusers. Similarly, about 41.9% of those who engaged in lifetime POM endorsed that prescription misuse was "very risky," as compared to 70% of non-misusers. Perceived risk by misuse for both PSM and POM are summarized in Figures 8 and 9, respectively.
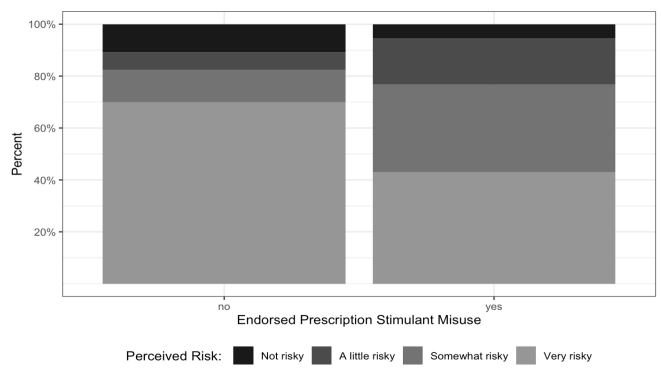
Figure 8

Perceived Risk and PSM

Figure 9

Perceived Risk and POM
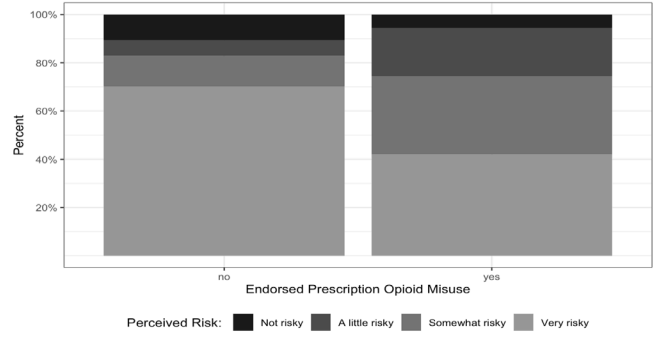
Objective #3: Initial Source and Initial Motive

The third study objective was to examine the relationship between initial motive for PSM/POM and initial source of prescription medication misused among college students. Chi-square tests of independence were conducted to examine these relationships. Cramer's V was calculated to determine the strength of these association. The initial source of medication misused variable for both PSM and POM violated the assumption of expected frequency with more than 20% of cells having expected frequencies of less than 5. In order to meet this assumption, initial source variables were recoded from the original ten response options into four categories for both PSM and POM. Original response options "from a valid doctor's prescription" and "leftover from an old prescription I obtained legally" were recoded to "from one's own prescription." Original response options "got from a friend or relative for free," "bought from a friend or relative," and "took from a friend or relative without asking" were recoded to "from a friend/relative." Original response options "bought from a drug dealer or stranger," "stole from a doctor's office/clinic/pharmacy," "bought from the internet," and "wrote a fake prescription" were recoded into "illicit means." No participants selected the "other" response option for PSM and only two participants selected the "other" option for POM. Because this option could not be collapsed into another response category meaningfully, these participants were excluded from these analyses. Additionally, the initial motive variable for PSM was recoded from the seven original response categories to four categories. "To help me concentrate" and "to increase alertness" were recoded into one response category "concentration/alertness." The original response options "to help me study" remained the same. And the other four original response categories "to get high,"

"to lose weight," "to counteract the effects of other drugs" and "other" were recoded into one response category, "other motive." The initial motive variable for POM was recoded from the five original response categories to three response categories: "to relieve physical pain," "to relieve emotional pain," and the three other original categories (i.e., "to feel good/get high, "to experiment," and "other") were collapsed into one category "enhancement/experiment."

A chi-square test of independence determined a significant relationship between motive for initial misuse of prescription opioids and initial source of prescription opioid medication misused, X^2 (6, n=103) = 13.45, $p < .05$. The size of the effect was small (Cramer's V = .19). As illustrated in Figure 10, participants endorsing relief of physical pain as their primary motive for their first time misusing prescription opioids were most likely to obtain the prescription opioid medication from their own doctor-provided prescription, whereas participants endorsing enhancement/experiment as their primary motive for their first time misusing prescription opioids were most likely to obtain the prescription opioid medication from a friend or relative. There was no statistically significant relationship between motive for initial misuse of prescription stimulants and initial source of prescription stimulant medication.

Figure 10

Initial Motive for POM and Initial Source of Prescription Opioid Medication Misused
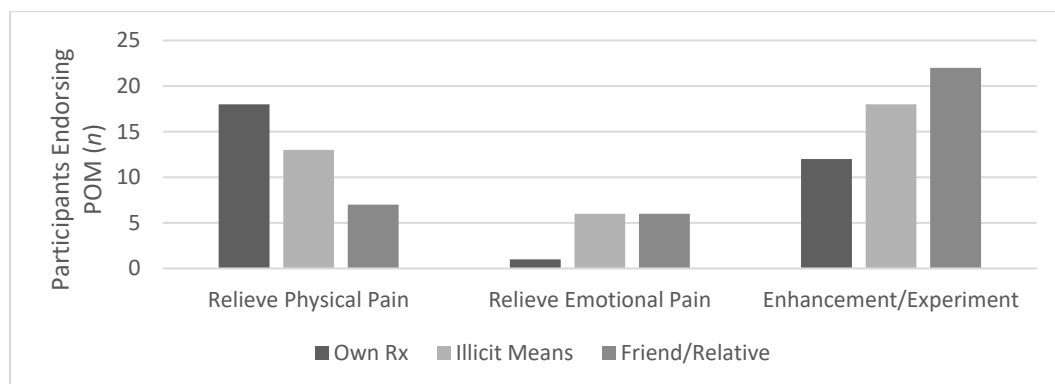
Discussion for Study 2

The goal of the present study was to explore perceived risk of prescription misuse and factors related to initial misuse of prescription stimulants and opioids. This purpose was realized through three research objectives. The first objective described the perceived risk, initial motives for misuse, and initial source of misused medication for prescription stimulants and prescription opioids in the sample of college students. The second objective examined the relationship between perceived risk of prescription medication misuse and lifetime PSM and POM among college students. The third objective examined the relationship between initial motive for misuse and initial source of prescription medication misused among college students.

Perceived Risk

Of the 616 participants in the study, 65.3% indicated that they found prescription misuse to be very risky (physically, legally, or otherwise), 16.1% found prescription misuse to be somewhat risky, 8.8% found prescription misuse to be a little risky, and

9.9% indicated that they did not find prescription misuse to be risky at all. There was a significant relationship between perceived risk and PSM such that those who denied engaging in PSM were more likely to endorse that prescription misuse is very risky (69.9%) than those who engaged in PSM at least once in their lifetime (43%). This relationship held true for perceived risk of prescription misuse and POM as well. Approximately 70% of participants who denied engaging in POM endorsed finding prescription misuse very risky, as compared to 41.9% of those who engaged in POM at least once in their lifetime. This is consistent with previous literature that suggests higher risk perception is associated with abstinence from misuse of prescription stimulants and prescription opioids (Brandt et al., 2014; Weyandt et al., 2022; Xu et al., 2020).

Interestingly, a greater proportion of those who denied engaging in PSM indicated that they found prescription misuse to be "not risky at all" (10.8%) than those who engaged in PSM at least once in their lifetime (5.6%). Similarly, 10.8% of those who denied engaging in POM indicated that prescription misuse is "not risky at all", as compared with 5.7% of those who engaged in POM at least once in their lifetime. For both PSM and POM, about 51-52% of those who engaged in misuse at least once in their lifetime endorsed that prescription misuse is "a little risky" or "somewhat risky," as opposed to only about 19% of those who denied misuse of prescription stimulants or opioids. This suggests that while high perceived risk is associated with abstinence from misuse of prescription opioids and prescription stimulants, low perceived risk is not necessarily indicative of misuse of prescription opioids or prescription stimulants. This is at odds with previous literature that has found that the relationship between perceived risk and misuse of prescription medication to be bidirectional (i.e., high perceived risk is

associated with abstinence from misuse and low perceived risk is associated with misuse;

Blevins et al., 2017; Brandt, 2014; Kenne et al., 2017). Rather than a bidirectional

relationship between perceived risk and engagement in PSM and/or POM, findings from

the present study suggest that those who abstain from PSM and/or POM have more

polarized views of risk (i.e., "very risky" or "not risky at all"), whereas those who have

engaged in PSM and/or POM have more nuanced perception of risk.

Initial Motive for Misuse

Previous research on motives for misuse of prescription stimulants has

documented academic motives and concentration as the most common motives for PSM

(Blevins et al., 2017; Teter et al., 2006). Consistent with these findings, in the present

study "to help me study" was the most common motive the first time participants

engaged in PSM (32.7%). The second most common motive was "to get high" (20.6%),

followed by "to help me concentrate" (18.7%).

Previous research on motives for misuse of prescription opioids has documented physical

relief as the most common motive for POM (McCabe et al., 2007; Weyandt et al., 2022).

The present study found relief of emotional pain to be the most common motive for

misuse, the first time participants engaged in POM (35.2%), followed by relief of

physical pain (29.5%), and to feel good or get high (20%).

Initial Source of Medication Misused

Consistent with previous research, participants in the present study were most

likely to obtain the prescription medication they misused from a friend or relative the first

time they misused prescription stimulants and/or prescription opioids (McCabe et al., 2007; McCabe et al., 2019). Of the 107 participants who endorsed lifetime PSM, 29.0% indicated that the first time they misused, they obtained the prescription stimulant medication misused from a friend or relative for free, 3.7% indicated that they took the prescription stimulant medication from a friend or relative without asking, and 14.0% indicated that they bought the prescription stimulant medication from a friend or relative. Of the 105 participants who endorsed lifetime POM, 26.7% indicated that the first time they misused prescription opioids, they obtained the prescription medication misused from a friend or relative for free, 16.2% indicated that they took the prescription opioid medication misused from their friend or relative without asking, and 6.7% indicated that they bought the prescription opioid medication from their friend or relative Proportions of participants who obtained the misused prescription medication from friends or relatives for free the first time they used are similar for both POM and PSM. However, a considerably larger proportion of those who misused prescription opioids obtained the misused medication by taking it from a friend or relative without asking than for PSM. Conversely, a considerably larger proportion of those who misused prescription stimulants obtained the misused medication by purchasing it from a friend or relative than for POM. This is consistent with previous research on diversion of prescription medications on college campuses that found that medical users of stimulants for ADHD were the most likely to be approached to divert their medication as compared to medical users of other types of prescription medication (McCabe et al., 2006). One reason for this discrepancy may be perceived acceptability of each type of prescription misuse. In other words, POM may be perceived to be less socially acceptable to friends/relatives than

PSM, and thus those misusing may feel more inclined to take it without asking so as to hide their misuse. The perceived acceptability of PSM among college students as a safe and even "necessary" means of doing well in school has been documented in previous research (Cutler, 2014; DeSantis & Hane, 2010, LaBelle et al., 2020). However, more research is needed to determine the perceived acceptability of POM among college students.

Initial Motive for Misuse and Source of Misuse

In the present study, there was a significant relationship between initial motive for misuse and initial source of medication misused such that those who engaged in POM for the first time were most likely to obtain the medication misused from their own prescription (i.e., leftover from an old prescription, used their own prescription in a way other than prescribed) and least likely to obtain the medication misused from a friend/relative (e.g., given for free, bought, or taken without asking from friend or relative). This is aligned with previous research in high school students that found the majority of participants that misused their own leftover prescription endorsed self-treatment motives (McCabe et al., 2019). Those who endorsed enhancement or experimental motives, including "to get high" and "to experiment" (17.1%) and those who endorsed emotional pain relief motives (16.2%) the first time they misused prescription opioid medications had substantially greater proportions of participants indicate illicit means of obtaining first medication misused than those who indicated physical pain relief motives (3.2%). There was not a significant relationship between initial motives for misuse and initial source of misused medication for PSM.

Implications and Limitations

Previous research has established that low perceived risk of harm predicts increased likelihood of substance use for many types of substance use, however, this relationship is less understood in the context of prescription opioid and stimulant misuse (Blevins et al., 2017; Brandt et al., 2014; Johnson et al., 2015; Kenne et al., 2017; Kollath-Cattano et al., 2020). The present study sought to address this gap in the literature. Findings suggest that while high perceived risk is associated with abstinence from misuse of prescription opioids and prescription stimulants, low perceived risk is not necessarily indicative of misuse of prescription opioids or prescription stimulants. Rather, those who abstain from PSM and/or POM have more polarized views of risk (i.e., "very risky" or "not risky at all"), whereas those who have engaged in PSM and/or POM have more nuanced perception of risk.

Several studies have sought to describe motives for prescription misuse and source of misused prescription medication and their sociodemographic correlates, however less research has examined the relationship between motives for misuse and source of misuse (Blevins et al., 2017; Boyd et al., 2009; McCabe et al., 2009; McCabe et al., 2007; McCabe et al., 2019; Teter et al., 2006; Weyandt et al., 2022). The present study demonstrated a relationship between initial motive for misuse and initial source of medication misused such that those who engaged in POM for the first time were most likely to obtain the medication misused from their own prescription and least likely to obtain the medication misused from a friend/relative. This suggests the need for more

research in this area, as a better understanding of this relationship may provide a pathway for prevention efforts.

While the present study sought to address important gaps in the literature, there are, however, limitations in the present study. First, the sample in the present study is primarily female (87%). This is significantly higher than the proportion of female undergraduates nationally (56.7%) and thus may limit generalizability (U.S. Department of Education, 2017). Second, the measure of risk used in this study asked about perceived risk of prescription misuse in general without specifying for classes of prescription misuse. As such, the present study was unable to examine similarities or differences in perceived risk across the two classes of prescription misuse. Future research may look specifically at similarities and differences in perceived risk of prescription stimulants versus prescription opioids and how these perceptions of risk are related to engagement in POM and/or PSM. And lastly, the present study was cross-sectional and analyzed self-report data. As such, we are unable to make causal inferences about the relationships between perceived risk and PSM/POM or between initial motives and source of medication misused. Further, we must acknowledge the potential for bias that comes with using self-report measures.

CHAPTER IV

CONCLUSION

This two-study dissertation explored factors related to POM and PSM in college students in order to assess between similarities and differences in correlates and trends. This study used an extant dataset from a previous study that employed a web-based survey, designed to assess substance use behaviors, predictors, motives, perceived risk and perceived peer attitudes towards prescription misuse among a national sample of undergraduate students.

The first study of this dissertation assessed similarities and differences in correlates of POM and PSM and used random forest and logistic regression analyses to build best fit multivariate models to optimize prediction of each outcome variable. This study also assessed for similarities and differences in correlates of engagement in misuse of one class of prescription medication (i.e., POM or PSM) versus misuse of both classes of prescription misuse, poly-prescription misuse (PPM). Findings from this study demonstrated some similarities in predictors of each type of misuse such that illicit substance use was a significant predictor of POM, PSM, and PPM, and engagement in one type of prescription misuse (i.e., POM or PSM) was the greatest predictor of engagement in the other type of prescription misuse (i.e., POM or PSM). This study also demonstrated some differences among predictors of each type of misuse such that best fit predictive models for POM and PSM had similar sensitivity, specificity, and prediction accuracy despite including a different set of predictor variables. For instance, depression and tobacco use were significant predictors of POM, but not PSM. Conversely, amount of friends who engage in prescription misuse and perceived acceptability of misuse were

significant predictors of PSM, but not POM. Further, marijuana use and perceived risk of prescription misuse were significant predictors of PPM, but not of POM or PSM.

The second study of this dissertation explored perceived risk of prescription misuse and motive and source of medication misused for initial misuse of prescription opioids and prescription stimulants. Findings from this study revealed similarities in the relationships between perceived risk of misuse and both POM and PSM, such that for both POM and PSM high perceived risk was associated with abstinence from misuse. However, rather than the bidirectional relationship between perceived risk and POM and/or PSM found in previous studies, findings from the present study suggest that participants who did not endorsed any misuse have more polarized views of risk (i.e., "very risky" or "not risky at all"), whereas those who endorsed POM and/or PSM have more nuanced perception of risk. The present study found that for both POM and PSM, participants were most likely to obtain the medication misused from friends or relatives the first time they misused. The most common motives for POM were emotional pain relief (35.2%), followed by relief of physical pain (29.5%), and to feel good or get high (20%), whereas the most common motives for PSM were "to help me study" (32.7%), followed by "to get high" (20.6%), followed by "to help me concentrate" (18.7%). There was a significant relationship between initial motive for misuse and initial source of medication misused for POM, such that those who endorsed physical pain relief motives for first time misuse were most likely to obtain the medication from their own prescription (i.e., leftover from an old prescription or taking medication in a way other than how it was prescribed). The relationship between initial motive for misuse and initial source of medication misused was not significant for PSM.

Given the widespread misuse of POM and PSM among college students and the associated risk of physical health, mental health, legal, and academic consequences, it is imperative to employ effective screening and prevention efforts. Overall, findings from the present dissertation provide evidence that while there are some similarities in correlates and trends of POM and PSM, there are also differences. This is important, as a better understanding of these differences can help to inform screening and prevention efforts to better identify and target those at most risk for misuse of each class of medication. To date, most research on prescription misuse among college students examines general prescription misuse without differentiating between classes of prescriptions or focuses on a singular class of prescription misuse, making it hard to directly assess for similarities and differences across classes of prescription. Instead, future research should continue to assess for similarities and differences in correlates and trends across classes of prescription misuse among college students. Additionally, further research should examine similarities and differences in correlates and trends between those who engage in less severe patterns of misuse (e.g., one time misuse) and those who engage in more problematic patterns of misuse (e.g., poly-prescription misuse or more frequent misuse).

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APPENDICES

Appendix A. Letter of Information

This research study is conducted by Dr. M. Scott DeBerard, Ph.D. and Julie Murray, B.A. in the Department of Psychology at Utah State University. The purpose of this research is to better understand the prevalence and predictors of substance use among college students. Your participation is entirely voluntary.

This form includes detailed information on the research to help you decide whether to participate. Please read it carefully before you agree to participate.

Procedures

Your participation will involve the completion of a 20-minute anonymous survey. We anticipate that 600 people will participate in this research study.

Risks

This is a minimal risk research study. That means that the risks of participating are no more likely or serious than those you encounter in everyday activities. The foreseeable risks or discomforts include You could possibly feel mild discomfort from answering some of the questions. You are welcome to stop being part of the study at any time. There are no penalties for stopping or choosing to not do any part of the study. There is a possibility that data could be lost or revealed to others; however, every effort has been made to protect your privacy and maintain your confidentiality.

Benefits

Although you will not directly benefit from this study, it has been designed to learn more about substance use in college students.

Confidentiality

The researchers will make every effort to ensure that the information you provide as part of this study remains confidential. Identifiable information will not be collected and thus your identity will not be revealed in any publications, presentations, or reports resulting from this research study. We will collect your information through Qualtrics. Online activities always carry a risk of a data breach, but we will use systems and processes that minimize breach opportunities. This data will be securely stored in an encrypted, cloud-based storage system.

Voluntary Participation & Withdrawal

Your participation in this research is completely voluntary. If you agree to participate now and change your mind later, you may withdraw at any time during the survey, by exiting the survey. Because participation is anonymous, you will not be able to withdrawal from the study after the survey is completed, as we will be unable to determine whose data is whose.

IRB Review

The Institutional Review Board (IRB) for the protection of human research participants at Utah State University has reviewed and approved this study. If you have questions about the research study itself, please contact the Principal Investigator at [435-797-1462]. If you have questions about your rights or would simply like to speak with someone *other* than the research team about questions or concerns, please contact the IRB Director at (435) 797-0567 or irb@usu.edu.

Appendix B. Survey Instrument

Demographics Questionnaire

1.   In what state is your University located?
     a. _____

2.   What is your biological sex?
     a. Male
     b. Female

3.   What is your age in years?
     a. _____

4.   Relationship Status
     a. Single (not involved)
     b. Married
     c. Divorced
     d. Separated
     e. In a committed romantic relationship

5.   Ethnic background
     a. American Indian or Alaskan Native
     b. Asian
     c. Black or African American
     d. Hispanic/Latinx
     e. Native Hawaiian or Pacific Islander
     f. White
     g. Other: _____

6.   Year in college
     a. Freshman
     b. Sophomore
     c. Junior
     d. Senior
     e. Other: _____

7.   Current living arrangement
     a. Residence hall/on-campus housing
     b. Living in fraternity/sorority housing
     c. Parent/guardian's home
     d. Other off-campus housing: _____

8.   What is your current grade point average?
     a. _____
     b. I have not yet established a grade point average

9.   What is your major area of study?

a. _____
b. I have not yet established a major

10. How important are school/grades to you?
a. Not important at all
b. A little important
c. Somewhat important
d. Very important

11. On average, how often are you in contact with your parents?
a. Multiple times per day
b. Daily
c. Weekly
d. Monthly
e. Less than monthly

12. How important is it to you to have your parent's/guardian's approval of your lifestyle and life choices?
a. Not important at all
b. A little important
c. Somewhat important
d. Very important

Items 12-22 will ask about prescription misuse. **Misuse** refers to taking medicine in a way or dose other than prescribed, taking someone else's prescription, or taking medicine for the effect it causes or to get high.

13. Please indicate which, if any, of the following medications you have **misused**
a. _____ hydrocodone (Vicodin)
b. _____ oxycodone (OxyContin, Percocet)
c. _____ oxymorphone (Opana)
d. _____ morphine (Kadian, Avinza)
e. _____ codeine (Tylenol 3)
f. _____ fentanyl

14. How often, if ever, have you **misused** any of the medications listed above?
a. Never misused
b. Misused, but not in the past 12 months
c. Misused, but not in the past 30 days
d. Misused in the past 30 days

15. How many times in your life, if ever, have you **misused** any of the medications listed above?
a. None
b. Once

    c. Twice
    d. 3-5 times
    e. 6-9 times
    f. 10 or more times

16.   If you have ever **misused** any of the medications listed above, please indicate how old you were when you misused it for the first time.
    a. _____ years old

17.   If you have ever **misused** any of the medications listed above, please indicate where you obtained the medication when you **misused it for the first time**.
    a. From a doctor's prescription
    b. Leftover from an old prescription I obtained legally
    c. Wrote a fake prescription
    d. Stole from a doctor's office/clinic/pharmacy
    e. Got from a friend or relative for free
    f. Bought from a friend or relative
    g. Took from a friend or relative without asking
    h. Bought from a drug dealer or stranger
    i. Bought from the internet
    j. Other: _____

18.   If you have ever **misused** any of the medications listed above, please indicate the primary reason for **misusing** the medication for the first time.
    a. To relieve physical pain (e.g., backache, tooth pain, etc.)
    b. To relieve emotional pain (e.g., depressed, nervous, sad, etc.)
    c. To feel good/get high
    d. To experiment
    e. Other: _____

19.   If you indicated that your primary reason for **misusing** one or more of the above medications was to relieve physical or emotional pain, please indicate why you chose to misuse the medication, rather than seek treatment for the physical/emotional pain. Select all that apply.
    a. _____ I needed immediate relief/could not wait for a doctor's appointment
    b. _____ I could not afford treatment
    c. _____ The pain was temporary and I thought it would go away
    d. _____ I had no health insurance
    e. _____ I was too embarrassed or did not want others to know about my pain
    f. _____ I did not think the doctor/hospital would help the problem
    g. _____ Other:_____

20. Please indicate which, if any, of the following medications you have **misused**
   a. _____ dextroamphetamine (Dexedrine)
   b. _____ dextroamphetamine/amphetamine combination product (Adderall)
   c. _____ methylphenidate (Ritalin, Concerta)
   d. _____ lisdexamfetamine (Vyvanse)

21. How often, if ever, have you **misused** any of the medications listed in item 18?
   a. Never misused
   b. Misused, but not in the past 12 months
   c. Misused, but not in the past 30 days
   d. Misused in the past 30 days

22. How many times, if ever, have you **misused** any of the medications listed in item 18?
   a. None
   b. Once
   c. Twice
   d. 3-5 times
   e. 6-9 times
   f. 10 or more times

23. If you have ever **misused** any of the medications listed above, please indicate how old you were when you misused it for the first time.
   a. _____ years old

24. If you have ever **misused** any of the medications listed in item 18, please indicate where you obtained the medication when you **misused it for the first time**.
   a. From a doctor's prescription
   b. Leftover from an old prescription I obtained legally
   c. Wrote a fake prescription
   d. Stole from a doctor's office/clinic/pharmacy
   e. Got from a friend or relative for free
   f. Bought from a friend or relative
   g. Took from a friend or relative without asking
   h. Bought from a drug dealer or stranger
   i. Bought from the internet
   j. Other: _____

25. If you have ever **misused** any of the medications listed in item 19, please indicate the primary reason for **misusing** the medication for the first time.
   a. To help me concentrate
   b. To help me study

    c. To increase my alertness
    d. To get high
    e. To lose weight
    f. To counteract the effects of other drugs
    g. Other: _____

Items 25-44 will ask about different types of substance use behaviors and opinions about substance use/misuse. Use refers to any consumption of the specified substance.

26. How often, if ever, have you used tobacco?
    a. Never used
    b. Used, but not in the past 12 months
    c. Used, but not in the past 30 days
    d. Used in the past 30 days

27. If you use tobacco, (i.e., smoke or oral use), how many servings* do you consume throughout one day? (One serving = 1 cigarette or that equivalent of oral tobacco product).
    a. None
    b. One
    c. Less than 6
    d. 7-19 servings
    e. 20 or more servings (one pack or more)

28. If you use tobacco, please indicate how old you were when you used a tobacco product for the first time.
    a. _____ years old

29. How often, if ever, have you consumed alcohol?
    a. Never used
    b. Used, but not in the past 12 months
    c. Used, but not in the past 30 days
    d. Used in the past 30 days

30. If you have consumed alcohol, please indicate how old you were when you consumed alcohol for the first time.
    a. _____ years old

31. Think back over the last month. How many times have you had five or more drinks* at one sitting? (A drink is a bottle of beer, a glass of wine, a wine cooler, a shot glass of liquor, or a mixed drink).
    a. None
    b. Once
    c. Twice
    d. 3-5 times

     e. 6-9 times
     f. 10 or more times

32.   How often, if ever, have you used marijuana?
     a. Never used
     b. Used, but not in the past 12 months
     c. Used, but not in the past 30 days
     d. Used in the past 30 days

33.   If you have ever used marijuana, please indicate how old you were when you used marijuana for the first time.
     a. _____ years old

34.   If you indicated you have used marijuana in the past 30 days, how many times in a typical week do you use marijuana?
     a. None
     b. Once
     c. Twice
     d. 3-5 times
     e. 6-9 times
     f. 10 or more times

35.   Please indicate which of the following drugs, if any, you have used in your lifetime.
     a. _____ cocaine
     b. _____ ecstasy/ MDMA
     c. _____ heroin
     d. _____ hallucinogens (LSD, mushrooms, salvia)
     e. _____ other: _____

36.   If you have ever used any of the drugs listed in item 34, please indicate how old you were when you misused it for the first time.
     a. _____ years old

37.   How often, if ever, have you each drug indicated in item 26?
     e. Never used
     f. Used, but not in the past 12 months
     g. Used, but not in the past 30 days
     h. Used in the past 30 days

38.   How many times, if ever, have you used each drug indicated in item 26?
     a. None
     b. Once
     c. Twice
     d. 3-5 times

e. 6-9 times
f. 10 or more times

39. Think about the friends you spend the most time with. How many of these friends engage in binge drinking (5 or more drinks in one sitting)?
    a. None of my friends
    b. A few of my friends
    c. Some of my friends
    d. Most of my friends
    e. All of my friends

40. How many of your friends smoke marijuana or other illegal drugs?
    a. None of my friends
    b. A few of my friends
    c. Some of my friends
    d. Most of my friends
    e. All of my friends

41. How many of your friends use prescription drugs in a way or dose other than prescribed, taking someone else's prescription, or taking medicine for the effect it causes or to get high?
    a. None of my friends
    b. A few of my friends
    c. Some of my friends
    d. Most of my friends
    e. All of my friends

42. How risky (physically, legally, etc.) is it to use prescription drugs in a way or dose other than prescribed, take someone else's prescription, or take medicine for the effect it causes or to get high?
    a. Not risky
    b. A little risky
    c. Somewhat risky
    d. Very risky

43. What kind of attitudes do your friends have towards using prescription drugs in a way or dose other than prescribed, taking someone else's prescription, or taking medicine for the effect it causes or to get high?
    a. Very negative
    b. Somewhat negative
    c. Neither positive or negative
    d. Somewhat positive
    e. Very positive

44. What kind of attitudes do your parents have towards using prescription drugs in a way or dose other than prescribed, taking someone else's prescription, or taking medicine for the effect it causes or to get high?
   a. Very negative
   b. Somewhat negative
   c. Neither positive or negative
   d. Somewhat positive
   e. Very positive

45. To what degree do you feel using prescription drugs in a way or dose other than prescribed, taking someone else's prescription, or taking medicine for the effect it causes or to get high is acceptable?
   a. Not acceptable
   b. Somewhat unacceptable
   c. Neither unacceptable or acceptable
   d. Somewhat acceptable
   e. Very acceptable

RCI-10

Instructions: Read each of the following statements. Using the scale to the right, choose the response that best describes how true each statement is for you.

Not at all true of me	Somewhat true of me	Moderately true of me	Mostly true of me	Totally true of me
1	2	3	4	5

	Not at all	Somewhat	Moderately	Mostly	Totally
1. I often read books and magazines about my faith.	1	2	3	4	5
2. I make financial contributions to my religious organization.	1	2	3	4	5
3. I spend time trying to grow in understanding of my faith.	1	2	3	4	5
4. Religion is especially important to me because it answers many questions about the meaning of life.	1	2	3	4	5
5. My religious beliefs lie behind my whole approach to life.	1	2	3	4	5

6. I enjoy spending time with others of my religious affiliation.	1	2	3	4	5
7. Religious beliefs influence all my dealings in life.	1	2	3	4	5
8. It is important to me to spend periods of time in private religious thought and reflection.	1	2	3	4	5
9. I enjoy working in the activities of my religious affiliation.	1	2	3	4	5
10. I keep well informed about my local religious group and have some influence in its decisions.	1	2	3	4	5

PSS

Instructions: The questions in this scale ask you about your feelings and thoughts during THE LAST MONTH. In each case, please indicate HOW OFTEN you felt or thought a certain way.

	Never	Almost Never	Some-times	Fairly Often	Very Often
1. In the past month, how often have you been upset because of something that happened unexpectedly?	0	1	2	3	4
2. In the past month, how often have you felt unable to control the important things in your life?	0	1	2	3	4
3. In the past month, how often have you felt nervous or stressed?	0	1	2	3	4
4. In the past month, how often have you felt confident about your ability to handle personal problems?	0	1	2	3	4

5. In the past month, how often have you felt that things were going your way?

0	1	2	3	4

6. In the past month, how often have you found that you could not cope with all the things you had to do?

0	1	2	3	4

	Never	Almost Never	Some-times	Fairly Often	Very Often
7. In the past month, how often have you been able to control irritations in your life?	0	1	2	3	4
8. In the past month, how often have you felt that you were on top of things?	0	1	2	3	4
9. In the past month, how often have you been angry because of things that happened that were outside of your control?	0	1	2	3	4
10. In the past month, how often have you felt difficulties were piling up so high that you could not overcome them?	0	1	2	3	4

PHQ-9

Over the last 2 weeks, how often have you been bothered by any of the following problems?

	Not at all 0	Several Days 1	More than half of the days 2	Nearly everyday 3
1. Little interest or pleasure in doing things	0	1	2	3
2. Feeling down, depressed, or hopeless	0	1	2	3
3. Trouble falling or staying asleep, or sleeping too much	0	1	2	3
4. Feeling tired or having little energy	0	1	2	3
5. Poor appetite or overeating	0	1	2	3
6. Feeling bad about yourself- or that you are a failure or have let yourself or your family down	0	1	2	3
7. Trouble concentrating on things, such as reading the newspaper or watching television	0	1	2	3
8. Moving or speaking so slowly that other people could have noticed? Or the opposite- being so fidgety or restless that you have been moving around a lot more than usual	0	1	2	3
9. Thoughts that you would be better off dead or of hurting yourself in some way	0	1	2	3

If you checked off any problems, how difficult have these problems made it for you to do your work, take care of things at home, or get along with other people?

        a. Not difficult at all
        b. Somewhat difficult
        c. Very difficult
        d. Extremely difficult

GAD-7

Over the last 2 weeks, how often have you been bothered by the following problems?

	Not at all 0	Several Days 1	More than half of the days 2	Nearly everyday 3
1. Feeling nervous, anxious, or on edge	0	1	2	3
2. Not being able to stop or control worrying	0	1	2	3
3. Worrying too much about different things	0	1	2	3
4. Trouble relaxing	0	1	2	3
5. Being so restless that it's hard to sit still	0	1	2	3
6. Becoming easily annoyed or irritable	0	1	2	3
7. Feeling afraid as if something awful might happen	0	1	2	3

If you checked off any problems, how difficult have these problems made it for you to do your work, take care of things at home, or get along with other people?

- e. Not difficult at all
- f. Somewhat difficult
- g. Very difficult
- h. Extremely difficult

Ways of Coping Questionnaire

Instructions: To respond to the statements in this questionnaire, you must have a specific stressful situation in mind. Take a few moments and think about the most stressful situation that you have experiences in the past week. As you respond to each of the statements, please keep this stressful situation in mind. Read each statement carefully and indicate, by selecting 0, 1, 2, or 3, to what extent you used it in the situation.

	Does not apply or not used	**Used somewhat**	**Used quite a bit**	**Used a great deal**			
	0	1	2	3			
1. I just concentrated on what I had to do next	0	1	2	3			
2. I tried to analyze the problem in order to understand it better	0	1	2	3			
3. I turned to work or another activity to take my mind off things	0	1	2	3			
4. I felt that time would have made a difference- the only thing was to wait	0	1	2	3			
5. I bargained or compromised to get something positive from the situation	0	1	2	3			
6. I did something that I didn't think would work, but at least I was doing something	0	1	2	3			
7. I tried to get the person responsible to change his or her mind	0	1	2	3			
8. I talked to someone to find out more about the situation	0	1	2	3			
9. I criticized or lectured myself	0	1	2	3			
10. I tried not to burn my bridges, but leave things open somewhat	0	1	2	3			
11. I hoped for a miracle	0	1	2	3			
12. I went along with fate; sometimes I just have bad luck	0	1	2	3			

	Does not apply or not used 0	Used somewhat 1	Used quite a bit 2	Used a great deal 3			
13. I went on as if nothing had happened				0	1	2	3
14. I tried to keep my feelings to myself				0	1	2	3
15. I looked for the silver lining, so to speak; I tried to look on the bright side of things				0	1	2	3
16. I slept more than usual				0	1	2	3
17. I expressed anger to the person(s) who caused the problem				0	1	2	3
18. I accepted sympathy and understanding from someone				0	1	2	3
19. I told myself things that helped me feel better				0	1	2	3
20. I was inspired to do something creative about the problem				0	1	2	3
21. I tried to forget the whole thing				0	1	2	3
22. I got professional help				0	1	2	3
23. I changed or grew as a person				0	1	2	3
24. I waited to see what would happen before doing anything				0	1	2	3
25. I apologized or did something to make up				0	1	2	3
26. I made a plan of action and followed it				0	1	2	3
27. I accepted the next best thing to what I wanted				0	1	2	3
28. I let my feelings out somehow				0	1	2	3
29. I realized that I had brought the problem on myself				0	1	2	3
30. I came out of the experience better than when I went in				0	1	2	3
31. I talked to someone who could do something concrete about the problem				0	1	2	3

	Does not apply or not used	Used somewhat	Used quite a bit	Used a great deal		
	0	1	2	3		
32. I tried to get away from it for a while by resting or taking a vacation	0	1	2	3		
33. I tried to make myself feel better by eating, drinking, smoking, using drugs, or medications, etc.	0	1	2	3		
34. I took a big chance or did something very risky to solve the problem	0	1	2	3		
35. I tried not to act too hastily or follow my first hunch	0	1	2	3		
36. I found new faith	0	1	2	3		
37. I maintained my pride and kept a stiff upper lip	0	1	2	3		
38. I rediscovered what is important in life	0	1	2	3		
39. I changed something so things would turn out all right	0	1	2	3		
40. I generally avoided being with people	0	1	2	3		
41. I didn't let it get to me: I refused to think too much about it	0	1	2	3		
42. I asked advice from a relative or friends I respected	0	1	2	3		
43. I kept others from knowing how bad things were	0	1	2	3		
44. I made light of the situation; I refused to get too serious about it	0	1	2	3		
45. I talked to someone about how I was feeling	0	1	2	3		
46. I stood my ground and fought for what I wanted	0	1	2	3		
47. I took it out on other people	0	1	2	3		

	Does not apply or not used	Used somewhat	Used quite a bit	Used a great deal		

48. I drew on my past experiences; I was in a similar situation before   0   1   2   3

49. I knew what had to be done, so I doubled my efforts to make things work   0   1   2   3

50. I refused to believe that it had happened   0   1   2   3

	Does not apply or not used 0	**Used somewhat** 1	**Used quite a bit** 2	**Used a great deal** 3
51. I promised myself that things would be different next time	0	1	2	3
52. I came up with a couple of different solutions to the problem	0	1	2	3
53. I accepted the situation, since nothing could be done	0	1	2	3
54. I tried to keep my feeling about the problem from interfering with other things	0	1	2	3
55. I wished that I could change what had happened or how I felt	0	1	2	3
56. I changed something about myself	0	1	2	3
57. I daydreamed or imagined a better time or place than the one I was in	0	1	2	3
58. I wished that the situation would go away or somehow be over with	0	1	2	3
59. I had fantasies or wishes about how things might turn out	0	1	2	3
60. I prayed	0	1	2	3
61. I prepared myself for the worst	0	1	2	3
62. I went over in my mind what I would say or do	0	1	2	3

63. I thought about how a person I admire would handle this situation and used that as a model	0	1	2	3
64. I tried to see things from the other person's point of view	0	1	2	3
65. I reminded myself how much worse things could be	0	1	2	3
66. I jogged or exercised	0	1	2	3

CURRICULUM VITAE

Julie Murray
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EDUCATION

PhD in Combined Clinical/Counseling Psychology—APA Accredited   Aug 2023
Utah State University (USU), Logan, UT
Dissertation Title: *Similarities and Differences in Correlates and Trends in*
Prescription Stimulant and Prescription Opioid Misuse among College Students
Dissertation Chair: Scott DeBerard, PhD

Master of Science in Psychology   July 2020
Utah State University (USU), Logan, UT
Master's Thesis: *College Prescription Opioid Misuse:*
An Exploration of Social Learning, Social Control, and Strain Theories
Thesis Chair: Scott DeBerard, PhD

Bachelor of Arts in Psychology   May 2013
Temple University, Philadelphia, PA

PROFESSIONAL AFFILIATIONS

2011-Present   Psi Chi National Psychology Honor Society
2016-Present   Society of Behavioral Medicine, Student Member
2017-Present   Health Psychology (Division 38), American Psychology Association
2018-2022   Utah Psychological Association, Student Member

PSYCHOLOGY INTERNSHIP

Medical College of Wisconsin (APA Accredited)
Adult Health Psychology Track, July 2022- Present
Director of Clinical Training: Heidi Christianson, PhD

July 2022-   **Behavioral Medicine and Primary Care Clinic**
Present   *Supervisor: Amber Craig, PhD*
- Provided psychological evaluation, brief psychotherapy, and health and behavior interventions for patients with co-occurring physical and mental health conditions
- Provided weekly supervision to a practicum student
- Engaged in weekly supervision with a licensed psychologist

July 2022-   **Inpatient Rehabilitation**
Sept 2022   *Supervisor: Rebeccah Manson, PhD*

- Provided diagnostic evaluations, brief psychotherapy, and behavioral health interventions for patients participating in Froedtert Hospital's CARF-accredited brain injury, stroke, spinal-cord injury, and general rehabilitation programs
- Participated in cotreatment with speech language pathology
- Provided brief training on behavioral pain management strategies for rehabilitation therapists
- Participated in weekly multidisciplinary rehabilitation team meetings
- Engaged in weekly supervision with licensed psychologist

Oct 2022-
Dec 2022

Cancer Psychology
Supervisors: Maria Olex, PsyD; Lyndsey Wallace, PsyD, ABPP

- Conducted pre-bone marrow transplant evaluations
- Generated integrated pre-bone marrow transplant evaluation reports and provided recommendations for patients and transplant team
- Co-facilitated an 8-week mindfulness based cancer recovery group
- Provided brief psychotherapy and health behavior intervention to oncology inpatients
- Collaborated with inpatient treatment teams (primary APP's, resident physicians, and fellow physicians) on psychological contributions to patient's care
- Engaged in weekly supervision with licensed psychologists

Jan 2023-
Mar 2023

Trauma and Critical Care
Supervisors: Terri deRoon-Cassini, PhD; Timothy Geier, PhD; Andrew Schramm, PhD

- Provided assessment, brief psychotherapy, and health and behavior intervention to patients in a Level 1 trauma center to address psychological and behavioral health needs of the trauma population and patients receiving emergent surgery

April 2023-
June 2023

Transplant Psychology
Supervisors: Stephanie Zanowski, PhD; Jenessa Price, PhD

- Conducted biopsychosocial assessment of candidacy for patients in evaluation for solid organ transplant and provide initial and ongoing psychosocial recommendations for patients and transplant team
- Provided psychotherapy and health and behavior intervention for patients pre- and post-transplant to address coping, adjustment, mood management, and medical adherence

CLINICAL EXPERIENCE

Sept 2021-   **Student Provider**

May 2022   McKay-Dee Outpatient Behavioral Health
Supervisors: Brian Bushman, PhD; Julie Goudie-Nice, PhD;
Brandon Adams, PsyD
- Conducted intake interviews, wrote intake reports, and therapy notes
- Provided individual therapy to adults in an outpatient setting
- Administered and scored neuropsychological battery for adults and adolescents
- Wrote neuropsychological reports and provided feedback to assessment clients
- Engaged in weekly individual with licensed psychologists
- Attended bi-monthly case presentations with a team of licensed psychologists

Total hours: 195
Direct contact hours: 96

Aug 2018-
May 2021   **Clinical Graduate Assistant/ Student Therapist**
Utah State University Student Health and Wellness Center
Supervisor: Scott DeBerard, PhD
- Conducted intake interviews, wrote intake reports, and therapy notes
- Generated recommendations, diagnoses, and/or referrals to specialty mental health care
- Provided brief individual therapy to university students using evidence based interventions
- Consulted with a multidisciplinary team of healthcare providers on medication side effects, case conceptualization, and treatment planning and adherence
- Engaged in weekly individual and group supervision with licensed psychologists

Total hours: 855.5
Direct contact hours: 362.5

Aug 2019-
Dec 2020   **Student Provider**
University of Utah Physical Medicine Rehabilitation Neuropsychology
Supervisors: Jeremy Davis, PsyD, ABPP; Katherine Kitchen Andren,

Ph.D.
- Conducted brief interviews with inpatient rehabilitation and outpatient neuropsychology patients
- Administered and scored neuropsychological battery
- Neuropsychological report writing
- Attended weekly multi-disciplinary rehabilitation team meetings for stroke and spinal cord injury teams
- Attended didactic trainings in brain anatomy, CBT-I for TBI, and neurocognitive pathologies

- Engaged in weekly individual supervision with licensed psychologist
Total hours: 220.25
Direct contact hours: 101.25

Aug 2019-   **Student Therapist**
May 2020   Brigham City Community Hospital Cardiac Rehabilitation
             Supervisor: Scott DeBerard, PhD
- Provided brief individual therapy to cardiac rehabilitation patients using evidence based interventions
- Provided monthly group stress-management, psychoeducation, and skills training to cardiac rehabilitation and diabetes patients and their families
- Collaborated with multidisciplinary team for patient care
- Conducted intake interviews, wrote intake reports and therapy notes
- Engaged in weekly individual supervision with licensed psychologist
Total hours: 102.5
Direct contact hours: 58.5

Aug 2017-   **Student Therapist**
June 2018   Utah State University Psychology Community Clinic
             Supervisors: Scott DeBerard, PhD, Sara Boghosian, PhD, Marietta

Veeder, PhD

- Conducted intake and diagnostic assessments
- Provided individual therapy to child, adolescent, and adult clients using evidence based interventions
- Received weekly individual and group supervision with licensed psychologists
Total hours: 305.5
Direct contact hours: 103.5

TRAININGS

May 2022   *Psychological Management of Somatic Symptom Disorder Workshop*
             Utah State University, Logan, UT

July 2020   *Cognitive Behavior Therapy for Insomnia*
             Self-paced online VA training

Oct 2019   *Upstander Training- Leaders safely intervening on harmful situations*
             Utah State University, Logan, UT

Feb 2018   *Allies on Campus Training for LGBTQIA+ Allies*
             Utah State University, Logan, UT

Jan 2018	*Safe Passages 4 U- Diversity Training* Utah State University, Logan, UT
Aug 2017	*Introduction to ACT & ACT Experiential Workshop* Michael P. Twohig, PhD, & Eric Lee, M.A. Utah State University, Logan, UT

RESEARCH EXPERIENCE

Aug 2016- Present	**Graduate Research Assistant** Health Psychology and Behavioral Medicine Lab (USU) *Principle Investigator: Scott DeBerard, Ph.D.* • Research investigating factors related to opioid misuse in college students and presurgical biopsychosocial predictors of surgical outcomes • Prepared protocols and study materials for IRB submission • Data collection, cleaning, and analysis • Preparation of conference abstracts and poster/paper presentation • Manuscript writing and preparation
July 2014- July 2016	**Research Assistant/Project Coordinator** Cancer Prevention and Control Program, Fox Chase Cancer Center Philadelphia, PA *Principle Investigator: Kuang-Yi Wen, Ph.D.* • Prepared protocols and study materials for IRB submission • Assisted in the development of online breast cancer patient portal • Managed recruitment, scheduling, and conducted semi-structured interviews with hospital outpatients • Reviewed electronic medical records • Data collection and analysis • Conducted literature reviews and assisted in conference poster preparation
May 2012- Aug 2013	**Undergraduate Research Assistant** Adult Anxiety Clinical of Temple, Temple University Philadelphia, PA *Principle Investigator: Richard G. Heimberg, Ph.D.* • Data collection and entry • Managed recruitment and participant tracking for several graduate student studies • Guided participants through online questionnaires and social interaction tasks • Assisted in conference poster preparation

POSTERS & PRESENTATIONS

Wallace, L., Banjeree, A., Molinaro, J., **Murray, J.,** Danhieux-Poole, C., Uselmann, A., Knight, J. (2023, March) *Optimizing the utility of the distress thermometer in cancer patients*. Abstract accepted as a poster presentation at the 2023 American Psychosocial Oncology Society (APOS), Portland, Oregon.

Murray, J., Gonzalez, H., Schwartz, S., Rattinger, G.B., Liu, Y., Hammond, A., Drewel, M., Kauzor, K., Tschanz, J. (2021, July) *Sleep disturbance and association with cognitive and functional trajectories in all cause dementia: The Cache County dementia progression study.* Poster presented at the 2021 Alzheimer's Association International Conference

Murray, J., DeBerard, M.S., Randazzo, K., (2020, April) *College prescription opioid misuse: An exploration of social learning, social control, and strain theories*. Paper accepted to the 2020 Society of Behavioral Medicine's 41th Annual Meeting (Meeting Cancelled due to Covid-19)

Dance, C., DeBerard, M.S., Warner, J., Randazzo, K., **Murray, J.** (2019, March) *Psychosocial impact of a brief Fitbit intervention for sedentary time at work.* Poster presented at the 2019 Society of Behavioral Medicine's 40th Annual Meeting, Washington, DC.

Murray, J., DeBerard, M.S., Seifert, S., Dance, C., Gundy-Cuneo, J. (2018, April) *Pre-surgical biopsychosocial correlates of lumbar fusion outcomes among Utah workers' compensation patients.* Poster presented at the 2018 Society of Behavioral Medicine's 39th Annual Meeting, New Orleans, LA.

DeBerard, M.S., Cuneo, J.G., Dance, C., Seiftert, S., **Murray, J.**, Tschanz, J. *Pre-surigcal correlates of post-surgical pain acceptance among Utah worker's compensation patients undergoing lumbar fusion.* (2017, April) Poster presented at the 2017 Society of Behavioral Medicine's 38th Annual Meeting, San Diego, CA.

Hu, A., Le Blanc, A. L., **Murray, J**., Patrick, K., Beck, J. R., Pendleton, D., …Wen, K. Y. *Development and evaluation of a mobile medication symptom support (M^2-PASS) system to strengthen cancer patients' transition from hospital to home.* Poster presented at the 2014 American Medical Informatics Association Annual Symposium, Washington, D.C.

Potter, C.M., Morrison, A.S., **Murray, J**., & Heimberg, R.G. *The influence of social anxiety, marijuana use, and substance use motives on urge to "pregame" among college drinkers.* Poster presented at the 2013 Association for Behavioral and Cognitive Therapies' 47th Annual Convention, Nashville, TN.

BOOK CHAPTERS

Murray J., Warner, J., DeBerard M.S. (March 2023) Spine surgery. In R. Marek & A. Block (Eds.) *Psychological assessment of surgical candidates: Evidence-based procedures.* American Psychological Association.

Murray J., Deberard S. (2022) Biopsychosocial Model & Health. In: R. Gurung (Ed.) *Encyclopedia of psychology in the real world.* Routledge. https://doi.org/10.4324/9780367198459-REPRW63-1

DeBerard S., **Murray J.** (2020) Heart Disease and Smoking. In: M. Gellman (Ed.) *Encyclopedia of behavioral medicine.* Springer. https://doi.org/10.1007/978-1-4614-6439-6_1615-2

Richard S.M., DeBerard S., **Murray J.** (2020) Lifestyle Changes. In: M. Gellman (Ed.) *Encyclopedia of behavioral medicine.* Springer. https://doi.org/10.1007/978-1-4614-6439-6_1616-2

Wheeler A.J., DeBerard S., **Murray J**. (2020) Assessment. In: M. Gellman (Ed.) *Encyclopedia of behavioral medicine.* Springer. https://doi.org/10.1007/978-1-4614-6439-6_1364-2

TEACHING EXPERIENCE

Aug 2021- May 2022	**Teaching Assistant** Psychology 3500: Research Methods in Psychology *Supervisor: Christopher Johnson, PhD* • Held weekly office hours for undergraduate students • Assisted students in development of a mock research proposal • Graded assignments and provided feedback to students
Aug 2020- Dec 2020	**Teaching Assistant** Psychology 3110: Health Psychology *Supervisor: Christopher Johnson, PhD* • Held weekly office hours for undergraduate students • Graded assignments and provided feedback to students
Aug 2019- Dec 2019	**Teaching Assistant** Psychology 1010: Introduction to Psychology *Supervisor: Jay Hinnekamp, MS* • Held weekly office hours for undergraduate students • Guest lectured classes on health psychology and stress
Jan 2018- May 2018	**Teaching Assistant** Psychology 6310: Intellectual Assessment *Supervisor: Marietta Veeder, PhD* • Graded student WAIS and WISC administration and protocols • Held weekly labs to facilitate practice and learning of WAIS and WISC protocols
Aug 2017-	**Teaching Assistant**

May 2018	Psychology 1010: Introduction to Psychology

Supervisor: Jennifer Grewe, PhD
- Graded assignments and facilitate online discussion board
- Guest lectured class on health psychology

Aug 2017- Dec 2017	**Teaching Assistant** Psychology 6350: Introduction to Theories of Intervention in Psychology

Supervisor: Sara Boghosian, Ph.D
- Graded assignments and assisted in demonstration of therapy skills

Aug 2016- May 2017	**Teaching Assistant** Psychology 1010: Introduction to Psychology

Supervisor: Kathryn Sperry
- Graded assignments, proctored exams, and met individually with students

AWARDS & HONORS

2023	Medical College of Wisconsin Department of Psychiatry and Behavioral Medicine Above and Beyond Award
2019	CEHS Graduate Student Research Award
2012	Golden Key International Honour Society
2011	Psi Chi Honor Society, Temple University Chapter
2011	National Society of Collegiate Scholars
2011 - 2013	Dean's List, Temple University College of Liberal Arts
2009 – 2013	Achievement Based Scholarships, Temple University Partial tuition remission