Illicit Substance Use and Mental Health Among Multiracial Young Adults in the United States

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Introduction

Substance use and mental health exhibit a well-established bidirectional relationship. Mental disorders can lead to substance use disorders, with, for example, major depression and alcohol dependence having a causal association (Polimanti *et al.*, 2019). Conversely, substance use disorders can worsen mental health through changes in brain structure as well as function (Filbey *et al.*, 2014). However, this relationship remains underexplored among multiracial young adults. In 2023, 14.1% of young adults (age 18-25) had co-occurring substance use and mental health disorder, and a similar trend is seen for multiracial adults (13.3 percent) (Substance Abuse and Mental Health Services Administration, 2024). In addition, 24.9% of Americans aged 12 or older used illicit drugs in the United States, and the percentage that reported using illicit drugs increased between 2021 and 2023. Given these trends, this study will address the following research question: To what extent does illicit substance use and mental health issues (e.g. major depressive episode, suicidal thoughts) correlate with each other among multiracial young adults aged 18–25? Illicit substances include any use of marijuana or cannabis products (including smoking, vaping, and other modes of use), cocaine (including crack), heroin, hallucinogens, inhalants, or methamphetamine, as well as misuse of prescription stimulants, tranquilizers or sedatives (e.g., benzodiazepines), or pain relievers. Multiracial refers to individuals who report being two or more races and not of Hispanic or Latino ethnicity.

Given trends revealing a common co-occurrence of substance use disorders and mental illness, I hypothesize that there is a moderately strong relationship between illicit substance use and mental health issues among multiracial youth. I attribute this to brain changes that occur from substance use in addition to factors such as discrimination and impulsivity. Inversely, I hypothesize that there is also a moderately strong relationship between mental health issues and illicit substance use. This could be explained by a need for coping mechanisms in response to these mental health conditions, experiences of discrimination, and impulsivity.

By capturing this bidirectional relationship, this study will provide targeted recommendations to the public health organizations (e.g. SAMHSA) on ways substance use in addition to mental health treatment can be improved in this problematic, underrepresented population. In addition, counselors and social workers will know more about how to address mental health or substance misuse issues in that population. Multiracial young adults will be further educated on why they should avoid misusing substances such as illicit drugs and how substance use connects to mental health. Prior studies have underrepresented the bidirectional relationship between substance use and mental health specifically among multiracial young adults, making this study a novel contribution.

This project will build on my background in health analytics, which involves performing analysis to provide recommendations on improving the health of patients in the healthcare system. In DA 301, utilizing large survey data, I gained experience relevant to my concentration, performing comprehensive health analysis on Denison students through doing summary statistics, trends analysis, comparative analysis, and correlation analysis. Similarly, in this project, with knowledge on initial summary statistics and trends, I will do a combination of comparative and **advanced** correlative techniques to gain a comprehensive understanding of the

bidirectional relationship between illicit substance use and mental health among multiracial youth. I expect the final output of this project to be a research paper, capturing the interesting findings of my complex bidirectional analyses, and a poster displaying key findings to the general public.

Methods

To answer my research question, I will utilize the 2023 NSDUH (National Survey on Drug Use and Health) **public use** data, which is the leading source of population-based statistical data on behavioral health information like tobacco use, alcohol use, drug use, and mental health. To maintain standards of privacy and confidentiality, the public use data files (downloadable) don't include identifying information, geographic identifiers, and variables such as interview mode or year the interview was administered. In addition, because I will use cross-sectional survey data in this research, I will not be able to establish causation. Moreover, self-report bias in the survey could lead to the results in this project being partially inaccurate. Also, given that multiracial youth is a small population, the results of this project won't be generalizable to other populations. The data contains variables such as demographics (age, race, income…), tobacco use, nicotine use, alcohol, illicit drug use (marijuana, cocaine…), substance use disorders, major depressive episode, suicidal thoughts, mental health service utilization, and substance use service utilization. The main variables from this data that I will include in my analysis are illicit drug use (overall use, marijuana, illicit drugs other than marijuana), major depressive episode, suicidal thoughts, any mental illness, serious mental illness, seen in emergency room for mental health, received treatment at mental health hospital, and demographics like age and race.

For the analytical piece, this research will incorporate bidirectional analysis on substance use and mental health because that will form a complete picture on how both substance use and mental health are interrelated. I will capture the bidirectional association with a combination of comparative bar plots, 2 sample z-tests, logistic regression, and machine learning (k-nearest neighbors) techniques. For example, I will see how multiracial youth that used marijuana in 2023 compares to multiracial youth that did not use marijuana with regards to MDE (major depressive episode) frequency by visualizing that comparison with bar plots, and seeing if the difference between the two groups is statistically significant with z-tests. Then, I will do logistic regression to see how much more likely those that use marijuana are to experience MDE compared to those that don't marijuana. Finally, I will conduct the k-nearest neighbors machine learning algorithm to capture potential non-linear relationships between marijuana use and MDE. In summary, I will see an initial glance of the bidirectional relationship between substance use and mental health with comparative bar plots, and I will test for statistically significant differences between groups with 2 sample z-tests. Meanwhile, I will capture the strength of the bidirectional relationship with the logistic regression and the k-nearest neighbors algorithm methods (**when a significant relationship is shown with the initial visualization and z-test**).

To address the bidirectional nature of the relationship, I will do at least separate visualizations and z-tests for each direction of the relationship (illicit substance use -> mental health, mental health->illicit substance use). Then, when relationships are found, I will subsequently do separate logistic regression analyses. In the regression analyses, I will control for potential confounders including socioeconomic status, education level, region, tobacco/alcohol use, and gender. Finally, after the logistic regression analyses, I will do separate

k-nearest neighbors algorithms for each direction of the relationship, and conduct sensitivity analyses to examine how mental health varies across different substances, and vice versa.

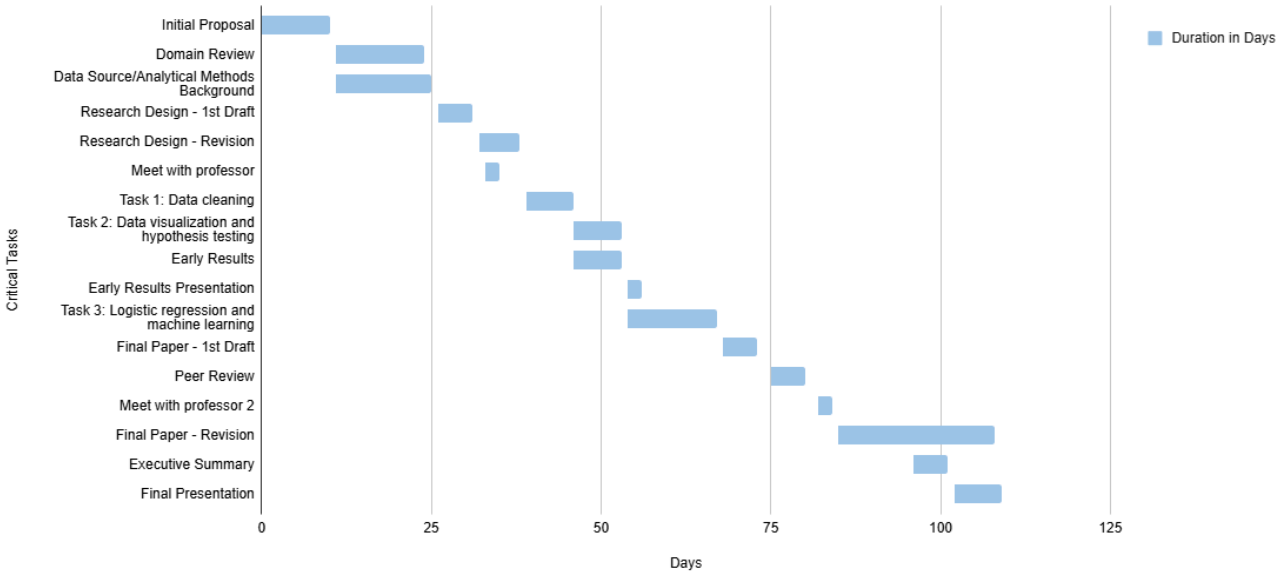
Preparation

To complete this project, I will be required to use the skills and methods of data collection, data manipulation, data visualization, hypothesis testing, logistic regression, and the k-nearest neighbors machine learning algorithm. I acquired my skills of data collection and data manipulation in DA 101 (RStudio), a 5 week research project (Python, SQL), and DA 210 (Python, SQL). I obtained my skills in data visualization and hypothesis testing in DA 101 (RStudio), a 5 week research project (Python), DA 210 (Python), and DA 220. I gained a background in step AIC logistic regression in DA 301. However, I will use my textbook from DA 220, youtube videos on logistic regression in R, and websites like OARC Stats that explain how to do logistic regression in R, so that I gain a better understanding of logistic regression. Finally, to obtain a background in the k-nearest neighbors machine learning algorithm, I will closely look at example applications of the algorithm from my DA 353 class (did a lab involving the algorithm). In addition, utilizing AI tools like google AI, I will research online on what the algorithm is and how to do it with categorical data in Python. Finally, I will review how to do data collection, data manipulation, data visualization, and hypothesis testing based on notes from the previous classes, textbooks from previous classes, and notes from the 5 week research project I did.

Background

My project requires background knowledge on the prevalence of illicit substance use as well as mental health among multiracial youth (shown in the introduction). In addition, based on existing research, it requires knowledge on how the relationship between substance use and mental health varies across different populations, mental health conditions, and substances. It also requires knowledge of potential outside factors that influence the relationship such as impulsivity and discrimination (specific to multiracial individuals). I developed this background by closely reading the 2023 NSDUH Annual National Report (referenced in introduction), and closely examining primary literature, mainly on PubMed. According to Han *et al.* (2022), young adults with past-year illicit LSD use had a greater risk of suicidal ideation and any/serious mental illness. Similarly, young adults (ages 18-35) enrolled in integrated care in community mental health settings that used alcohol, illicit drugs, or cannabis with tobacco had higher mental health symptoms (Ferron *et al.*, 2024). While this research, similar to what I will do in my research, examines the relationship between illicit substance use as well other substances and mental health, what this research doesn't do is capture the **bidirectional** relationship between substance use and mental health among **multiracial youth** specifically. In addition, Jones *et al.* (2017) found that discrimination (higher among black adults) is directly associated with psychological distress and higher illicit substance use. While this research does look at how discrimination influences the relationship between mental health and illicit substance use, it once again doesn't examine the same relationship among **multiracial youth** that I will capture in my research.

Timeline



I will meet with my faculty advisor two times a week to talk about progress on the research project.

My project timeline is carefully structured to ensure the efficient completion of each task. Here's a brief overview of my project plan with estimated durations in days:

- Initial Proposal (10 days): I begin with creating this project proposal, outlining the project, what my expected output is, its intellectual merit, and how I plan to complete the project successfully.
- Domain Review (13 days): I will write a literature review that summarizes, synthesizes, and critiques literature related to my project topic.
- Data Source/Analytical Methods Background (14 days): I will obtain a **detailed** background on my project data source, analytical methods I already know (e.g. data collection, data visualization), and analytical methods newer to me (logistic regression, machine learning).

- Research Design - 1st Draft (5 days): I will write the first draft of the research design paper, carefully outlining the data collection and analytical methods of my research.
- Research Design - Revision (6 days): I will revise my research design paper.
- Meet with professor (2 days): I will meet with faculty advisor to get feedback on research design.
- Data Cleaning (7 days): I will clean the data for my project, ensuring it's relevant, descriptive, and tidy.
- Data Visualization and Hypothesis Testing (7 days): I will create comparative barplots and do 2 sample z-tests to spot initial relationships between substance use and mental health among multiracial youth, and vice versa.
- Early Results (7 days): I will write a document outlining the early results of my project.
- Early Results Presentation (2 days): I will present the early results of my project.
- Logistic Regression and Machine Learning (13 days): I will examine the bidirectional relationship between illicit substance use and mental health among multiracial youth in-depth.
- Final Paper - 1st Draft (5 days): I will write the first draft of my final paper, containing the interesting findings of my complex bidirectional analyses.
- Peer Review (5 days): I will closely review classmates' final papers.
- Meet with professor (2 days): I will meet with my faculty advisor to get advice on how to improve my final paper.
- Final Paper - Revision (23 days): I will dedicate plenty of time to revising my final paper until it's finished.

- Executive Summary (5 days): I will write a one-page executive summary outlining the results of my project in a digestible manner.
- Final Presentation (7 days): I will present the poster of my project that illustrates the key findings.

This timeline is designed to ensure a systematic and thorough execution of each project task, leading to a successful project completion.

References

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