THESIS

EXAMINING THE MODERATING EFFECTS OF RACE/ETHNICITY AND SOCIOECONOMIC STATUS ON THE ASSOCIATION BETWEEN SUBSTANCE MISUSE AND MENTAL HEALTH IN ADOLESCENCE

Submitted by

Kyle Hatch

Department of Human Development and Family Studies

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Master's Committee:

Advisor: Nathanial R. Riggs

Mark Prince
Gloria Luong

ABSTRACT

EXAMINING THE MODERATING EFFECTS OF RACE/ETHNICITY, SOCIOECONOMIC STATUS ON THE ASSOCIATION BETWEEN SUBSTANCE MISUSE AND MENTAL HEALTH IN ADOLESCENCE

Adolescence has been shown to be a critical time for healthy development, however, research has suggested that substance use is high during this developmental period. Adolescent substance use is of concern, as it can lead to negative developmental health outcomes. Specifically, adolescent cannabis use has been associated with mental health outcomes like depression. This thesis sought to investigate the relationship between adolescent cannabis use and depression, and to test potential moderators such as race/ethnic identity and socioeconomic status (SES) in this relationship. It was found that adolescent cannabis use, along with assigned female sex at birth and low-SES, were associated with increased depressive symptoms in adolescence. Race/ethnic identity and SES did not significantly moderate the relationship between adolescent cannabis use and depression. Implications of these findings and suggestions for future studies are discussed.

TABLE OF CONTENTS

INTRODUCTION

Substance misuse is defined as the continuous use of substances, either legal or illegal, that can have negative effects on an individual's physical and mental health, social relationships, and responsibilities. The troubling effects associated with substance misuse can impact both the individuals' misusing substances and society at large (Das et al., 2016). Substance misuse is associated with a variety of mental and physical health problems (Das et al., 2016; Hasin et al., 2016; Meier et al., 2012) and is a major contributor to the global burden of morbidity and mortality (Peacock et al., 2018). Overall, the problems associated with substance misuse put great burden on social and economic resources, making substance misuse a complicated public health concern (Das et al., 2016; Peacock et al., 2017; Whiteford et al., 2015).

Mental health disorders such as depression also pose public health concerns (Esmaeelzadeh et al., 2018; Whiteford et al., 2015). Mental health disorders are among the leading causes of disability and contribute to a significant proportion of disease burden (Whiteford et al., 2015). Researchers have argued that the global burden of mental illness is underestimated, suggesting that this burden accounts for 32% of years lived with disability (Vigo et al., 2016).

Research has shown that both mental health disorders and substance misuse often start in adolescence. Adolescence is a period of growing social pressure which creates increasing opportunities to engage in risky behaviors such as substance use (Das et al., 2016; Renya & Farley, 2006). Furthermore, research has suggested that substance misuse is prevalent among adolescents (Das et al., 2016). 2020 Monitoring the Future data show that lifetime prevalence rates for high school seniors were 24.0% for tobacco, 61.5% for alcohol, 47.2% for vaping, and 43.7% for cannabis use (Johnston et al., 2020). In addition to substance misuse rates,

adolescence is also a critical time for the development of mental health disorders. Approximately 8.4% of adolescents in the United States are diagnosed with either anxiety or depression, and it is estimated that 50% of all mental health disorders start by the age of 14 (Kessler et al., 2007).

There is a positive association between substance misuse and mental disorders in adolescence (Esmaeelzadeh et al., 2018). For example, mental health outcomes, such as depressive symptoms, are associated with future use of substances (Esmaeelzadeh et al., 2018). However, research has also suggested that substance use during adolescence is associated with future negative mental health outcomes such as major depression and generalized anxiety disorder (Cranford, Eisenberg, & Serras, 2009; Das et al., 2016). As such, it is important to further investigate the relationship between adolescent substance use and mental health outcomes, as the onset of substance use during adolescence may be a risk factor for mental health disorders.

One way to further understand the ways by which adolescent substance use and mental health are related is to examine potential moderating variables of this relationship. Moderation analyses can be useful for asking questions such as "for whom is this relationship strongest?" (MacKinnon & Luecken, 2008). Moderation analyses can therefore allow researchers to determine if the association between adolescent substance misuse and mental health is different depending on a third variable, including being a member of specific demographic groups. Demographic characteristics such as race/ethnicity and socioeconomic status (SES are variables that potentially moderate the relationship between adolescent substance misuse and mental health. Testing a potential moderating role for each of these demographic factors is essential and could inform the need for culturally and contextually sensitive prevention and intervention strategies.

This thesis will summarize the current research on substance misuse and mental health in adolescence from a sociocultural informed lens. First, I will provide an overview of adolescent substance misuse prevalence rates and the negative health outcomes associated with substance misuse. Identified risk factors associated with both substance misuse and negative mental health outcomes in adolescence will then be summarized. Finally, ethnicity and SES will be introduced as potential moderating variables in the relationship between substance misuse and mental health outcomes. Hypotheses for how these variables affect the relationship between adolescent substance use and mental health outcomes will then be summarized.

LITERATURE REVIEW

Substance Misuse in Adolescence

Prevalence

Substance use prevalence is high among adolescents and young adults (Bidwell et al., 2015; Das et al., 2016; Reyna & Farley, 2006; Cranford, Eisenberg, & Serras, 2009; Johnston et al., 2020). For example, although adolescent use of combustible tobacco products has decreased significantly in the past few decades, use of other nicotine products such as e-cigarettes has increased significantly (Jonhston et al., 2021). While alcohol use among adolescents has been declining since the late 1970's, use is still high, and rates of availability are high as well (Johnston et al., 2021). Finally, daily cannabis use among 8th graders, 10th graders, and 12th graders rose in 2019, and was at the highest level since 1991 (Johnston et al., 2019).

Onset of cannabis use almost always occurs during adolescence (Das et al., 2016; Renya & Farley, 2006). The growing rates of daily cannabis use among adolescents is of particular concern and research has already identified adolescence as a critical time for cannabis usage. Specifically, experimentation with illicit drugs such as cannabis begins during adolescence (Das et al., 2016; Johnston et al., 2019) and research has suggested that cannabis is among the substances most used by adolescents (Esmaeelzadeh et al., 2018). Cannabis misuse during adolescence is of great concern, as adolescence is a critical time of development for neurobiological higher-order cognition (i.e., executive function) processes such as inhibitory control and working memory, and the use of cannabis during this time can hinder this development (Larsen & Luna, 2018). Therefore, any cannabis use during adolescence may be considered misuse.

Despite these findings, the social attitudes toward adolescent cannabis use in the United States are changing; many states have legalized cannabis usage for retail or medicinal use, and public polls suggest that a growing majority of adolescents now see cannabis use as posing very little or no risk for harm (Carliner et al., 2017). Research on how changing social attitudes towards cannabis use has impacted adolescent cannabis use is limited, however, some research has suggested that retail cannabis legalization is associated with increases in the likelihood of adolescent past-30 day cannabis use (Paschall, Garcia-Ramirez, & Grube, 2021). It is therefore necessary to examine adolescent cannabis use specifically to further understand the roles cannabis use plays in adolescent mental health.

Etiology of Cannabis Use

The etiology of cannabis use during adolescence is a multi-contextual phenomenon that is influenced by individual, peer, family, and ecological factors. Considering the high prevalence rates of cannabis use and the negative outcomes associated with use in adolescence, researchers have sought to identify potential factors associated with use to develop effective intervention and prevention strategies. Currently, there is a strong body of research suggesting family history of substance use, peer networks, novelty seeking behaviors, executive functioning deficits (specifically in regards to inhibitory control), quality of parenting, gender, and low socioeconomic status as factors associated with cannabis use in early stages of development (Bidwell et al., 2015; Cranford, Eisenberg & Serras, 2009; Riggs et al., 2016; Das et al., 2016; Pentz & Riggs, 2013; Champers, Taylor, & Potenza, 2003; Pentz et al., 2015; Rena & Farley, 2006; Riggs et al., 2007).

Negative Outcomes Associated with Adolescent Cannabis Use

Cannabis use during adolescence is associated with several negative outcomes including increased risk for developing substance use related disorders and problems into adulthood (unemployment, accidents, and decreased life expectancy) (Bidwell et al., 2015; Das et al., 2016). Among the disorders is cannabis use disorder, which is characterized as the continued dependent use of cannabis, despite clinical challenges associated with use. Cannabis use disorder affects one in ten adolescents, and cannabis use during adolescence increases further risk of developing cannabis use disorder as an adult (Chandra et al., 2019; Das et al., 2016). Furthermore, the negative effects of use are often exacerbated by other co-occurring negative mental health outcomes (Cranford, Eisenberg, & Serras, 2009). Specifically, adolescent cannabis use is associated with internalizing problems such as an inability to feel positive affect (Leventhal et al., 2017). Finally, adolescent cannabis use is associated with the prevalence of mental health outcomes such as depression and anxiety disorders (Hasin et al., 2013).

Mental Health in Adolescence

Mental health outcomes such as depression disorders are common during adolescence (NIMH, 2021). Depressive disorders are mood disorders categorized by persistent feelings of sadness, hopelessness, or pessimism that can negatively impact how individuals think, feel, or handle day to day activities (NIMH, 2021). Roughly 13% of adolescents in the United States expressed symptoms of a depressive disorder over a 12-month period (NIMH, 2021). Broadly speaking, experiencing depression in adolescence can disrupt important developmental processes which can have longstanding psychosocial effects, both in adolescence and again in adulthood (Clayborne et al., 2019). Specifically, adolescent depression can interfere with academic performance and relational development (Clayborne et al., 2019). Finally, adolescent depression

is associated with future depression in adulthood, and is associated with higher odds of experiencing negative psychosocial outcomes in adulthood such as a failure to complete secondary education, unemployment, and unwanted pregnancy (Clayborne et al., 2019).

While cannabis use during adolescence is associated with future negative mental health outcomes, a smaller yet growing body of research suggests that mental health may also be associated with future substance use in adolescents and young adults. Research examining the directionality of the relationship between mental health and substance misuse suggested that depressive symptoms in adolescence are positively associated with future cannabis use (Esmaeelzadeh et al., 2018; Wilkinson et al., 2016).

Adolescent depression is also associated with future onset of a substance use disorder in adulthood (Taylor, 2011). Furthermore, extreme mental health conditions such as intense depression and suicidal ideation are associated with increased risk of illicit drug use (Zhang & Wu, 2014). Symptoms of anxiety during adolescence were similarly associated with future use of cannabis (Esmaeelzadeh et al., 2018), with anxiety also being a risk factor for substance use disorders such as cannabis use disorder (Kedzior & Laeber, 2014). Cannabis use has also been found to be highest among adolescents with previous anxiety related disorders (Conway et al., 2016).

Potential Moderators of the Association between Cannabis Use and Mental Health Problems

While previous research has suggested a strong positive association between adolescent cannabis misuse and adolescent mental health outcomes, few studies have examined potential moderators to this relationship. The effect of cannabis use on adolescent mental health outcomes may be moderated by other variables if its strength or direction depends on those variables

(Hayes, 2017). As such, it is important to examine demographic identities as potential moderators to the relationship between adolescent cannabis misuse and mental health outcomes to identify for whom this relationship is stronger or weaker. Doing so will help inform the development of culturally and contextually sensitive cannabis misuse and mental health treatment interventions.

Among the potential moderating factors are demographic identities such as race, ethnicity and socioeconomic status (SES). Race refers to a category of people that shares certain distinctive physical traits, and ethnicity refers to a grouping of people based on shared attributes that distinguish them from other groups such as a common set of traditions, ancestry, language, history, culture, or nationality. While race and ethnicity are separate constructs, they share common factors. As such, "race/ethnicity" will be used to refer to race and ethnicity together as a potential moderator moving forward. SES is defined as a measure of one's combined economic and social status. Intersectionality refers to the intersecting and overlapping of multiple demographic identities that may be empowering or oppressing. Little attention has been given to how race/ethnicity and SES affect both the prevalence of misuse in adolescence, and the relationship of misuse with mental health outcomes of individuals in these developmental stages.

Race/Ethnicity as a Moderator in the Association between Adolescent Cannabis Use and Mental Health Outcomes

While previous research has established that adolescence is a time when use of substances is high and that use of substances during this time is associated with negative mental health outcomes such as depression (Das et al., 2016; Johnston et al., 2019), little research has examined the role race/ethnicity plays in this relationship. Therefore, more research testing the ways by which these two are associated is needed. Critical race theory may be an informative

framework guiding investigations into the potential role that ethnicity may play in the development of substance misuse and mental health problems. Critical race theories represent ways of thinking about and assessing social systems and groups that incorporate recognition of the following principles: race is a central component of social organizations and systems, racism is an *institutionalized* and ingrained feature of racialized social systems, and racial and ethnic identities are not fixed entities but rather are socially constructed (Burton et al., 2010). Furthermore, critical race theory acknowledges that race and ethnicity are stratified, in that there is structured inequality where access to resources and risk to negative outcomes is dependent on ethnic group membership (Burton et al., 2010). A branch of critical race theory is LatCrit, which examines social experiences unique to the Latinx community (Perez-Huber, 2010). LatCrit theory can be used to theorize and examine the ways in which institutionalized racism and racial stratification explicitly and implicitly impact the social structures of Latinx communities in the United States (Solorzano & Yosso, 2001).

Research informed by critical race theory has identified several examples of the ways in which racial and ethnic differences among families in the United States are socially constructed and institutionalized. For example, children from differing ethnic backgrounds may have different home environments in which they grow and develop. Compared to families from ethnic minority groups, White families may have more economic, social, and environmental advantages than parents from other groups, and average household income for White families is about twice that of other groups (Nam, Wikoff, & Sherraden, 2015). In addition to higher risk of lower socioeconomic status, the effects of lower socioeconomic status and poverty are far worse for ethnic minority families (Hackman et al., 2015; Nam, Wikoff, & Sherraden, 2015; Rhoades et al., 2011).

Along with potential discrimination in quality of home environment, another example of how ethnic differences are socially constructed concerns parenting quality and parenting related stress. While parenting quality may serve as a protective factor to some of the risks posed by low socioeconomic status, a parent's ethnic identity may have a negative influence on parenting quality, which may then have an impact on the healthy development on children from ethnic minority families. It has been found that parents with ethnic minority backgrounds may experience more barriers to successful parenting than White parents, and that these barriers can hinder parenting quality as well as the ability of parents to provide a positive home environment (Hackman et al., 2015; Nam, Wikoff, & Sherraden, 2015). Furthermore, while parenting stress is associated with developmental risks for children of all ethnicities, research has shown that it is highest among Latinx families in the United States (Nam, Wikoff, & Sherrden, 2015; Wagner & Valdez, 2020).

One further way that the experiences of Latinx individuals might be socially constructed and institutionalized in the United States is in the way they affect the relationship between substance misuse and mental health outcomes among adolescents and young adults. Previous research examining the role ethnicity has on the effects of poverty and parenting quality has suggested the need for studies to include ethnicity as a variable of consideration in the relationship between other public health concerns such as adolescent substance misuse and mental health. Furthermore, past research has suggested a difference in substance use rates between White adolescents and Latinx adolescents, with usage rates being somewhat higher for Latinx adolescents (Johnston et al., 2019).

It is imperative to include ethnicity as a variable to consider when investigating factors that affect the relationship between substance misuse and mental health, as an individual's ethnic

identity may serve as either a protective or risk factor for both initiation of substance use and the mental health outcomes associated with misuse. Therefore, ethnicity is one variable that may moderate the relationship between adolescent cannabis use and mental health outcomes and subsequently suggest if this relationship is stronger depending on ethnic identity.

SES as a Moderator in the Association between Adolescent Cannabis Use and Mental Health Outcomes

Research investigating the effects of SES on the relationship between adolescent cannabis use and mental health is less prevalent than research investigating effects of ethnicity. This is surprising, as low SES is a well-established risk factor for a variety of health concerns. Therefore, it is important for socioeconomic adversities to be considered in the prevention of cannabis misuse among adolescents (Knaapila et al., 2020). Research examining the relationship between adolescent cannabis use and socioeconomic status is challenging, as adult education and income levels are yet to be accomplished in adolescence; however, parental education and living with both parents are often used as a proxy measurement of adolescent SES (Knaappila et al., 2015). Adolescent cannabis use has been found to be associated with low parental education and not living with both parents (Knaapila et al., 2020).

HYPOTHESES

Given the current literature on the relationship between adolescent substance use and mental health outcomes, it is hypothesized that there will be a direct association between adolescent cannabis use and mental health outcomes. Specifically, Hypothesis 1 is that past 30-day cannabis use in 9th grade will be positively associated with depressive symptoms in 12th grade. The second hypothesis of this study is informed by critical race theory. Critical race theory posits that racism is stratified in the United States, suggesting that access to desired resources is not the same across different racial and ethnic groups (Burton et al., 2010). Resources such as substance misuse intervention and mental health care are potential resources wherein access is different across different racial and ethnic groups. Therefore, Hypothesis 2 is that ethnicity *will* moderate the strength of the relationship between substance use and adolescent mental health, in that the strength of the relationship between substance misuse and depression will be *higher* for Latinx individuals than it will be for White individuals. If confirmed, results will contribute to empirical evidence that suggests Latinx adolescents are at a greater risk for experiencing negative mental health outcomes like depression following the onset of substance use than White adolescents. If confirmed, results will also suggest that prevention and intervention strategies aimed at preventing substance misuse and mental health should consider demographic differences to provide culturally responsive services.

Hypothesis 3 is that SES will moderate the relationship between substance use and adolescent mental health such that this relationship will be stronger for lower-SES participants than for higher-SES participants. A significant interaction effect of cannabis use by SES on depression will indicate that adolescents from lower-SES backgrounds are at greater risk for

developing symptoms of depression following cannabis use than those from higher-SES backgrounds.

METHODS

Participants

Data were extracted from the Happiness and Health survey, a longitudinal cohort study assessing substance use and mental health outcomes among adolescent students in Los Angeles, California. Participants in this survey were high school students selected as a convenience sample from high schools in the Los Angeles Metropolitan Area. High schools were selected in the Los Angeles Metropolitan area due to high population density and demographically diverse student populations in this area. Study investigators approached 40 high schools in Los Angeles for participation in the study; of these, 10 schools across 4 different school districts were selected. Students at all 10 schools were told of the study by their homeroom teachers and were given written parental consent and written student assent forms to fill out before participating.

Exclusion criteria for participation in the Happiness and Health survey included both being involved in special education programs in school, and not having English as a first language. All other students in the 10 schools were eligible for participation. Of the 4100 students eligible for participation, 3396 were able to provide both written parental consent and written student assent and were therefore enrolled in the study. Eighteen hundred and one (53.2%) participants identified as female, 1568 (46.3%) participants identified as male, and 14 (0.4%) did not report an assigned sex at birth. Thirty-four (1.0%) participants were American Indian or Alaska Native, 560 (16.6%) were Asian, 16.6 (4.9%) were Black or African American, 1605 (47.4%) were Latinx or Hispanic, 139 (4.1%) were Pacific Islander, 544 (16.1%) were White, 225 (6.7%) were Multiracial, 53 (1.6%) were other, and 57 (1.7%) did not identify their ethnicity. Participant age ranged from 12-16 years old. The results are highly generalizable to the overall adolescent population in the United States.

Procedure

Only participants who could provide both written parental consent *and* student assent were eligible to participate in the study. Written parental consent was obtained by having potential participants bring back to school a written permission document signed by a legal parent or guardian to have their children participate in the study. Student assent was obtained by having potential participants sign a similar document signifying their approval to participate in the study. Research assistants further ensured informed consent by having *all* students return informed consent documents back to school, regardless of if their parents provided consent. Doing so also ensured that everyone who could provide written parental consent could participate in the study. Trained research assistants explained to participants that their participation in the study was completely voluntary, that they would be able to withdraw at any time, and that their responses to survey materials would be kept completely confidential and that responses would not be shared with school administration, parents, or teachers. Participants were also informed that their responses would be anonymous, in that no member of the research team would be able to identify them based off their responses to the surveys.

A cross-sectional field survey design was used to collect data for the proposed study. A cross-sectional field study design was appropriate because independent variables or treatments were not manipulated (Bhattacherjee, 2012). Furthermore, the utilization of a cross-sectional field study design was appropriate because both independent and dependent variables were measured at the same time, in addition to the moderating variable. Finally, a cross-sectional field survey design was appropriate because the goal of this study is not to measure this association over time, rather it is to examine the association of all the variables at the *same* time, and how this association is affected by a third moderating variable.

Research assistants visited each of the schools that elected to participate in the study and administered two pen-and-paper survey materials to eligible participants during a required 40-minute class period. These two surveys sought to assess for mental health outcomes and substance use rates among participants. As previously mentioned, only students who could provide both written parental consent and written student assent were eligible to complete survey materials; students who were not eligible to participate in the study were given a separate worksheet from their course instructor to complete instead while eligible participants completed the surveys. Following the 40-minute class period, research assistants collected both surveys from participants and saved them for later use in data analysis. In addition to measures assessing the independent and dependent variables in the study, demographic characteristics such as participant ethnicity, socioeconomic status, and gender were also assessed.

Measures

Depression.

For mental health outcomes, specifically depression, participants were asked to complete the *Center for Epidemiologic Studies Depression Scale* (CES-D) (Radloff, 1977). The CES-D scale is a 20-item questionnaire in which respondents self-report the frequency of their depressive symptoms experienced in the last week. Items ask respondents to report the frequency of symptoms they felt in the past week on a 0 (never) to 3 (a lot) likert-scale. Research investigating the reliability and validity of this measure has found that the CES-D has high test-retest reliability, high internal consistency, and high convergent and divergent validity (Gonzalez et al., 2017; Jiang et al., 2019; Van Dam & Earleywine, 2011).

Substance Misuse.

For cannabis use rates, participants were asked to complete items from the *Youth Risk Behavior Survey* (YRBS) Questionnaire. Specifically, cannabis use measures assessing for past 30-day use were used. Participants were asked to report the daily use of either alcohol or marijuana from the past 30-days on a six-point 0-5 scale (0=no days used, 1=1-2 days used, 2=3-5 days used, 3=6-9 days used, 4=10-14 days used, 5=15-30 days used). This measure has shown to be a reliable and valid measure of substance use rates in adolescence (Brener et al., 1995). Lifetime measures of cannabis use do not indicate how prevalent or frequently adolescents have used cannabis, while past-week measures of cannabis use may not capture use enough as adolescents may not be using cannabis every week. Therefore, past-30 day use was measured in order to provide a balance between being sensitive and specific enough to pick up amount of cannabis use.

Moderators.

Race/Ethnicity and Socioeconomic Status (SES) served as the moderators in the analysis of potential moderators to the relationship between adolescent cannabis use and mental health. The race/ethnicity and SES variables were coded dichotomously. Ethnicity was coded as 0 for Latinx and 1 for White. Reduced cost lunch vs. no reduced cost lunch was used as a proxy measure for SES, and was coded as 0 for no reduced lunch at school and 1 for reduced cost lunch at school. An interaction term between race/ethnicity and cannabis use was created to assess any potential moderating effects of race/ethnicity on the relationship between adolescent cannabis use and depression. Additionally, an interaction term between SES and cannabis use was created to assess any potential moderating effects of SES on the relationship between adolescent cannabis use and depression.

Data Analysis Strategy

Descriptive statistics were computed for all variables after examining the data for outliers and/or any other data anomalies. Specifically, means, standard deviations, skewness, and kurtosis will be calculated for cannabis use and depression by race/ethnicity, gender, and SES. Analyses were conducted using a Generalized Linear Model with a negative binomial distribution. A generalized linear model with a negative binomial distribution specified for the outcome variable was selected as the method of analysis for this thesis because it is able to examine regression with a skewed, over dispersed count distribution for the dependent depression variable. Missing values for all variables were addressed by imputing a single complete data set using all variables included in the analysis. Imputation is accepted as the best general method to deal with incomplete data, as it reflects the uncertainty of the missing data (VanBuuren, 2018).

A total of 6 generalized linear models with negative binomial distribution were conducted. The 1st generalized linear model examined the main effects of adolescent cannabis use and SES on depression, the 2nd analyzed the effects of adolescent cannabis use, SES and the interaction of adolescent cannabis use and SES on depression outcomes, and the 3rd examined the effects of adolescent cannabis use, SES, and the interaction of adolescent cannabis use and SES on depression outcomes, with ethnicity and assigned sex at birth serving as covariates. The 4th generalized linear model examined the main effects of adolescent cannabis use and ethnicity on depression, the 5th analyzed the effects of adolescent cannabis use, ethnicity, and the interaction of adolescent cannabis use and ethnicity on depression, and the 6th examined the effects of adolescent cannabis use, ethnicity, and the interaction of adolescent cannabis use and ethnicity on depression outcomes, with SES and assigned sex at birth serving as covariates.

RESULTS

Preliminary Analyses

Descriptive statistics for all variables were conducted as part of the preliminary analyses. Of the 3,396 participants, 1,870 reported being male (55.1%) and 1,634 reported being female (48.1%). 2,876 participants reported that they did not use cannabis in the past-30 days (77.7%), and 756 reported that they did use cannabis in the past-30 days (22.3%). Regarding race and ethnicity, 2,876 participants reported being White (84.7%), and 520 participants reported being Latinx (15.3%). The average CESD score was 15.75 (*SD=11.87)*, with a skewness of 0.80 and kurtosis of 0.44.

Bivariate correlations for all variables are illustrated in Table 1 below. Past-30 day cannabis use had a significant positive correlation with SES ($r=.034, p<0.05$), a significant positive correlation with ethnicity ($r=.044, p<.05$), and a significant positive correlation with depression ($r=.10, p<.001$). Past-30 day cannabis use was not significantly correlated with assigned sex at birth ($r=.026, p>.05$). SES had a significant negative correlation with ethnicity ($r=-.257, p<.001$), a significant negative correlation with assigned sex at birth ($r=-.056, p=.001$), and a significant positive correlation with depression ($r=.077, p<.001$). Ethnicity was not significantly correlated with assigned sex at birth ($r=-.014, p>.05$) or with depression ($r=-.028, p<.05$).

Table 1

Correlations

Variable	CU	SES	Ethnicity	ASB	Depression
CU	1				
SES	.034*	1			
Ethnicity	.044*	-.257**	1		
ASB	0.026	-.056**	-.014	1	
Depression	.099**	.077**	0.028	-.258**	1

Note. Table 1 illustrates bivariate correlations.
* Indicates significance at the .05 level
** Indicates significance at the .01 level

Goodness of fit statistics for each of the 6 generalized linear models are provided in Table 2 below. Goodness of fit statistics were conducted as part of each generalized linear model in the SPSS statistical software program and were provided with the primary results of each generalized model; as such, all six generalized linear models were conducted and the results from the goodness of fit statistics of each model was used to determine what primary results to report. Akailke's Information Criterion (AIC) was used to determine which of each model was the best fit for the data; lower AIC values correspond to better fit models. The 3rd generalized linear model (*AIC=25002.835)* and the 6th generalized linear model (*AIC=25002.847*) had the lowest AIC values of each of the 6 models, and the results of each are reported on Table 2 below.

Table 2	Deviance	Pearson Chi-Square	Akailke's Information Criterion (AIC)	df
1a. MJ + SES	2832.41	2086.409	25140.446	3393
1b. MJ + SES + MJ*SES	2832.403	2086.208	25142.444	3392
1c. MJ + SES + MJ*SES + covariates	2688.806	1980.375	25002.835	3390
2a. MJ + Ethnicity	2841.359	2100.121	25149.388	3393
2b. MJ + Ethnicity + MJ*Ethnicity	2841.239	2099.764	25151.28	3392
2c. MJ + Ethnicity + MJ*Ethnicity + covariates	2688.793	1980.649	25002.847	3390

Note. Table 2 illustrates Goodness of Fit estimates for the Generalized Linear Model.

a. MJ=Adolescent Cannabis Use
SES=Socioeconomic Status
ASB=Assigned Sex at Birth

Primary Results

Cannabis Use. The hypothesis that adolescent cannabis use would predict depressive symptoms was supported (see Table 3 below). Specifically, the generalized linear model examining the main effects of adolescent cannabis use, SES, ethnicity, and assigned sex at birth on depressive symptoms demonstrated that adolescent cannabis use was associated with greater depressive symptoms, with $N=3396$, $B(3391)=0.19$, $exp(B)=1.21$, and $p<.001$ (see table 3). The

exponentiated *B* coefficient of 1.21 in this model is a multiplicative term that suggests past 30-day cannabis use is associated with 1.21 times increase in depressive symptoms.

Ethnicity. The second hypothesis that ethnicity would moderate the relationship between adolescent cannabis use and depression was not supported by the results, *N=3396, B(3392)= 0.014, exp(B)=1.01,* and *p=0.898* (see Table 3). Despite the finding of a null interaction between adolescent cannabis use and ethnicity, significant main effects were found. Assigned sex at birth and SES were included as covariates in the generalized linear model, with both variables suggesting significant main effects on depressive outcomes. Specifically, assigned sex at birth had a significant main effect on depressive symptoms, *N=3396, B(3390)= -0.43, exp(B)= 0.65, p=0.00* (see table 3). The exponentiated *B* coefficient of 0.65 in this model suggests that when controlling for ethnicity, being male is associated with experiencing 0.65 times less depressive symptoms than being female. SES also had a significant main effect on depressive symptoms in this model, with *N=3396, B(3390)=0.07, exp(B)=1.08,* and *p=0.048*. The exponentiated *B* coefficient of 1.08 in this model suggests that when controlled for ethnicity, utilizing the free/reduced lunch service at school was associated with a 1.08 times increase in depressive symptoms.

SES. The third hypothesis that SES would moderate the relationship between adolescent cannabis use and depression was not supported, *N=3396, B(3392)= -0.005, exp(B)= 0.99,* and *p=0.96*. Despite a non-significant interaction between adolescent cannabis use and SES, significant main effects were found. Assigned sex at birth and ethnicity were included as covariates in the first generalized linear model, with assigned sex at birth having a significant main effect on depressive outcomes (*N=3396, B(3390)= -0.434, exp(B)= 1.08,* and *p=0*) and ethnicity not having a significant main effect on depressive outcomes (*N=3396, B(3390)= -*

0.058, *exp(B)=0.94,* and *p=0.258*). The exponentiated *B* coefficient of 1.08 for assigned sex at birth in this model suggests that when controlling for SES, being male is associated with experiencing 1.08 times more depressive symptoms than being female.

Table 3 *This table illustrates parameter estimates from the Generalized Linear Model*	**Term/Predictor**	**B**	**SE**	**exp(B)**	**p**
1. MJ + Ethnicity + MJ*Ethnicity + covariates	Intercept	2.771	0.034	15.97	0
	CU = Yes	0.187	0.047	1.2	<.001
	Ethnicity=White	-0.061	0.059	0.94	0.296
	MJ*Eth	0.014	0.113	1.01	0.898
	ASB	-0.434	0.036	0.65	0
	SES	0.073	0.037	1.08	0.048
2. MJ + SES + MJ*SES + covariates	Intercept	2.77	0.035	15.96	0
	CU = Yes	0.192	0.061	1.21	0.002
	SES = Free/Reduced Lunch	0.074	0.041	1.08	0.074
	MJ*SES	-0.005	0.085	0.99	0.962
	ASB	-4.34	0.036	1.08	0
	Ethnicity	-0.058	0.051	0.94	0.258

Note. Table 3 illustrates parameter estimates from the Generalized Linear Model.

a. CU=Adolescent Cannabis Use
SES=Socioeconomic Status
ASB=Assigned Sex at Birth
Latinx=1, White =0
No Free/Reduced Lunch=0, Free/Reduced Lunch=1

DISCUSSION

Interpretation of Findings

This thesis examined the association between adolescent cannabis use and depression outcomes, and whether ethnicity and SES moderated this relationship. Hypothesis 1 of this thesis was that cannabis use during adolescence would be significantly and positively associated with depression. This hypothesis was supported. This result contributes to a well-established literature suggesting that substance use during adolescence serves as a risk factor for mental health outcomes during this age period.

The second hypothesis of this study was informed by critical race theory which posits that racism is stratified in the United States, suggesting that access to desired resources is not the same across different racial and ethnic groups (Burton et al., 2010). In the context of adolescent substance use and mental health, critical race theory suggests that resources such as substance misuse intervention and mental health care are potential resources wherein access is different, or stratified, across different racial and ethnic groups. Therefore, Hypothesis 2 was that ethnicity would moderate the strength of the relationship between adolescent cannabis use and depression, such that the strength of the relationship between adolescent cannabis use and depression will be higher for Latinx adolescents than it will be for White adolescents. Such a finding would lend support to the need to consider demographic identity differences, such as differences in race and ethnicity, in the development of effective prevention and intervention efforts.

Contrary to this hypothesis, Latinx ethnicity did not moderate the association between adolescent cannabis use and depression. This null finding can be interpreted in a couple ways. First, it may suggest that Latinx adolescents are not at a greater risk for developing negative mental health outcomes following the onset of cannabis use than White adolescents.

Additionally, a null finding of Hypothesis 2 could suggest that *any* cannabis use, regardless of difference in usage rates between Latinx or White adolescents, leads to risk of depression outcomes. Identifying as Latinx or White was not found to significantly change the relationship between adolescent cannabis use and depression. Therefore, a null finding of Hypothesis 2 could suggest that despite any potential differences in substance use/mental health resource access between Latinx adolescents and White adolescents, cannabis use alone is still a significant risk factor for depression outcomes that does not change based off ethnicity. This null finding therefore suggests that adolescent cannabis use is a broad public concern that has negative implications regardless of demographic identity differences such as race or ethnicity.

The third hypothesis of this thesis was that SES would moderate the relationship between adolescent cannabis use and mental health outcomes was not supported. A significant effect of cannabis use by SES on depression would have indicated that adolescents from lower-SES backgrounds are at greater risk for developing symptoms of depression following cannabis use than those from higher-SES backgrounds. This null finding can also be interpreted in a couple of different ways. First, similar to Hypothesis 2, a null finding of Hypothesis 3 might suggest that lower-SES adolescents are not at a greater risk for developing negative mental health outcomes following the onset of cannabis use than higher-SES adolescents are. This would also suggest that any cannabis use, regardless of SES, is associated with depressive symptoms in adolescents. This finding, again, emphasizes that adolescent substance use is a broad public health concern that is associated poor negative mental health outcomes such as depression regardless of demographic differences such as SES.

Despite null moderating effects of ethnicity and SES on the relationship between adolescent cannabis use and mental health outcomes, this thesis did find significant evidence of

main effects of adolescent cannabis use, SES, and assigned sex at birth on depressive symptoms. Specifically, it was found that higher levels of adolescent cannabis use are associated with increases in depressive symptoms, regardless of ethnicity or SES. This finding lends support to the idea of adolescent cannabis use as a broad public health concern. In addition to cannabis use, SES and assigned sex at birth were found to have main effects on depression. Specifically, being from a lower-SES background was associated with increased depressive symptoms, regardless of ethnicity or cannabis use. This finding contributes to a body of literature that suggests that low-SES is associated with poorer mental health outcomes.

Finally, assigned sex at birth was found to have a main effect on depression outcomes such that being female was associated with increased depressive symptoms. This finding contributes to a body of literature suggesting that being female is associated with poorer mental health outcomes. It is important to acknowledge that those from lower-SES backgrounds or those who identify as female are not necessarily at fault for these associations, rather, the social and political context around being from a low-SES background and identifying as female could be driving these associations.

This thesis found that adolescent cannabis use, lower-SES, and assigned female sex at birth are all associated with depressive symptoms during adolescence. This thesis did not find evidence that racial/ethnic identity, nor SES, moderated the relationship between adolescent cannabis use and depressive symptoms. These findings confirm past research findings suggesting that assigned sex at birth and SES are associated with mental health outcomes. Furthermore, these findings fail to confirm hypotheses that racial/ethnic identity or SES moderated this relationship. Implications of these findings, as well as suggestions for future studies, are provided below.

Implications and Future Directions

The finding that adolescent cannabis use was associated with increased depressive symptoms emphasizes the need to develop adequate prevention and intervention strategies to target adolescent cannabis use as a potential contributor to poor mental health outcomes including as depression. Furthermore, the finding that neither ethnicity nor SES moderated the relationship between adolescent cannabis use and depression suggests that adolescent cannabis use is a broad public health issue, that may predict depression regardless of differences in demographic identity. As such, future studies should continue to investigate the role that cannabis use during adolescence has on mental health; both in adolescence itself and in later adulthood.

Despite null moderation findings, future studies should also still take into consideration any differences in racial/ethnicity identity and SES. Race and ethnicity are stratified in the United States, suggesting that access to desired societal resources may not be the same across different racial and ethnic groups (Burton et al., 2010). Additionally, SES is heavily intertwined with racial and ethnic identity in the United States. As such, experiences of both substance use and mental health may be different among different racial/ethnic groups and social classes. Future studies therefore need to continue to take into consideration racial/ethnic identity, SES, and other demographic identities into consideration to fully understand how adolescent substance use and mental health outcomes are related to one another.

It is possible that null findings in this thesis are a result of how the variables of this thesis were operationalized. Specifically, cannabis use was measured dichotomously as either “yes” or “no” use in the past-30 days for this thesis. Future studies could instead examine if *frequency* of cannabis use in the past-30 days, or lifetime use is significantly associated with adolescent

depressive symptoms, and if racial/ethnic identity or SES interactions with this association. Additionally, future studies could also examine additional mental health outcomes to depression, such as anxiety.

Limitations

The findings of this thesis should be interpreted within the context of its limitations. One limitation of this thesis is the utilization of a cross-sectional, rather than longitudinal, research design. Cross-sectional research designs examine differences in data at one point in time, whereas longitudinal research designs examine changes in data over a period of time. For this thesis, a cross-sectional design was used to examine the relationship between adolescent cannabis use and depression outcomes in 12th grade, and if ethnicity or SES would moderate any relationship between these two variables. Future studies could instead employ a longitudinal design method, to examine if changes in cannabis usage over time result in changes in depression over time, and if these changes correspond with ethnicity and SES. Additionally, while the cross-sectional design utilized in this thesis allowed for the examination of associations between variables, a longitudinal design would be able to provide more insight into any temporal cause-effect relationships between variables.

Another limitation of this thesis concerns the thesis's generalizability. Participants in this thesis were from the Los Angeles Metropolitan Area. The Los Angeles metro area has many affluent Latinx communities and many poor White communities, an ethnic difference in SES not common throughout the rest of the United States. Furthermore, since Los Angeles is the second biggest city in the United States, results from the Los Angeles metro area may not be representative of more rural communities in the United States. Future studies should address this issue of generalizability by examining nationally representative samples from both rural and

urban settings to provide a more nationally representative understanding of how adolescent cannabis use affects mental health.

An additional limitation concerns the use of assigned sex at birth in the analysis as opposed to gender. While assigned sex at birth is a dichotomous characterization that refers to being assigned either biologically male or female at birth, gender is a more fluid concept that refers to a wide spectrum of identities that do not necessarily correspond to being either biologically male or female. As such, assessing for gender instead of assigned sex at birth could provide more in-depth insight into how different identities affect the relationship between adolescent cannabis use and mental health outcomes.

Another limitation of this thesis concerns the use of free-reduced lunch as a measure of low-SES. Free-reduced lunch in school is a proxy for low-SES, however, SES is a complex construct that has been measured in multiple different ways. While free-reduced lunch is a validated measure of SES, the use of only one validated measure as opposed to the use of multiple (such as parental education, parental income, etc.) may have failed to capture the complexity of this variable. A final limitation of this thesis concerns the timeframe in which the data was collected. Data for the Happiness and Health survey was collected between 2012-2016, before the COVID-19 pandemic that began towards the end of 2019. The COVID-19 pandemic has had great societal impacts on health and well-being; as such, future studies examining potential moderators to the relationship between adolescent cannabis use and mental health should analyze data collected following the COVID-19 pandemic in order to provide more current and contemporary findings.

SUMMARY/CONCLUSIONS

This thesis examined the relationship between adolescent cannabis use and depression outcomes, and whether ethnicity and SES moderated this relationship. While ethnicity or SES did not moderate the relationship between adolescent cannabis use and depression, adolescent cannabis, SES, and assigned sex at birth were significantly associated with depression during the 12th grade. These findings contribute to literature suggesting that cannabis use, low-SES, and female identity are all risk factors to poorer mental health outcomes in adolescence. Specifically, these findings emphasize the need to address adolescent cannabis use as a broad public health issue that may have negative effects on adolescent mental health outcomes regardless of identity. Furthermore, these findings emphasize the need for future research to consider certain risk factors to poor mental health outcomes in adolescence to develop effective treatment strategies that can meet each adolescent struggling with mental health where they are.

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