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Mental Health, Substance Use, Sociodemographic and Attitudinal Correlates of
Marijuana Use during Pregnancy

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Abstract

Mental Health, Substance Use, Sociodemographic and Attitudinal Correlates of Marijuana Use during Pregnancy

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Background: Marijuana is the most common illicit drug used during pregnancy in the United States with a significant increase in prenatal use from 2002 to 2013[1-5]. Noting the ongoing legalization of marijuana among U.S. states, the gaps in literature require a more specific examination of comorbid mental health conditions associated with marijuana use during pregnancy.

Objective: The purpose of this study is to investigate whether an association exists between marijuana use during pregnancy and having serious psychological distress among females of reproductive age in the United States, when adjusting for other sociodemographic, substance use, mental health, and attitudinal factors.

Methods: Data from NSDUH 2014, a cross-sectional nationally representative survey, identified pregnant women aged 12-44 years self-reporting marijuana use in the past month (4.5%, weighted n=103,582) and self-reporting no use of marijuana in the past month (95.5%, weighted n=2,223,191). Weighted descriptive frequencies and a multiple logistic regression analysis were conducted using specialized survey procedures in SAS 9.4 statistical software.

Results: When adjusting for maternal age, trimester, cigarette use, perceived risk of smoking marijuana, and depression, pregnant women who had serious psychological distress in the past month had increased odds of using marijuana in the past month (OR=6.667, 95% CI: 1.148 – 38.707) when compared to pregnant women who did not have serious psychological distress. Cigarette use in the past month was the most significant correlate (p<0.0001) of marijuana use in the past month among pregnant women (OR=12.443, 95% CI: 3.822 – 40.512) when adjusting for all other correlates in the final model, while age, trimester, and perceived risk of smoking marijuana were also significant correlates of prenatal marijuana use in the adjusted model.

Conclusion: The results from this study characterize cigarette use in the past month and psychological distress in the past month as the two most significant correlates of prenatal marijuana use. Although inconclusive, previous research posits a range of poor birth outcomes and fetal developmental deficits potentially associated with prenatal marijuana use. Therefore, addressing comorbid mental health and substance use conditions may be helpful in reducing marijuana use during pregnancy while further research is required to more fully understand the short-term and long-term outcomes of prenatal marijuana use.

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CHAPTER I: INTRODUCTION

INTRODUCTION AND RATIONALE

Marijuana is the most common illicitly used drug during pregnancy in the United States[5].

As an increasing number of states are legalizing or decriminalizing marijuana for both

medicinal and/or recreational purposes, it can be anticipated that marijuana use may

continue to rise among the general, as well as the pregnant, population. Public use data

from the National Survey on Drug Use and Health (NSDUH) indicates a significant

increase in marijuana use during pregnancy from 2002-2013[1-4].

Maternal marijuana use is often presumptive of use prior to pregnancy, since initiating

use during pregnancy is less conceivable and has not been reported as a common trend.

Marijuana abuse or dependence was actually diagnosed in 18% of pregnant marijuana

users, when compared to only 11.4% of non-pregnant users, and represents a long-term

development of a substance use disorder that is contributing to continued marijuana use

during pregnancy[3]. Treatment admissions data also show that in 2012, 20% of pregnant

women entering substance abuse treatment reported marijuana as their primary problem

substance, reflecting a greater than three-fold increase since 1992[1, 5].

Preliminary analysis of patterns of marijuana use among women of reproductive age (18-

44 years) showed that approximately 70% of pregnant women perceived slight or no risk

of using marijuana once or twice a week[3]. Relaxed attitudes toward marijuana use can

serve as a motivating factor in continuing use during pregnancy.

Since a pregnant female essentially embodies two patients, the mother and the developing fetus, prenatal exposure to substance use continues to be an ongoing public health concern with a potential for salient consequences. A growing awareness of this issue is acknowledged by research presenting a range of poor fetal neurodevelopmental effects, negative birth outcomes, and long-term psychiatric effects afflicting the exposed fetus and newborn[6-11]. More explicitly, outcomes include high risk pregnancies, low birth weight, neonatal withdrawal symptoms, cognitive deficits, congenital malformations, and child maltreatment[6, 12]. These types of consequences can then equate to societal burdens in cost related to extended hospital stays and special educational services for children with impairments resulting from prenatal exposure to marijuana.

A review of demographic and socio-contextual determinants of marijuana use for pregnant versus non-pregnant women yielded the following as potential risk factors: age, education, income, religiosity, marital status, tobacco use, history of marijuana use, and marijuana use by the biological father[13]. Mental disorders, ranging from psychiatric conditions to depression to social anxiety, were also shown to be significantly predictive of marijuana use, mainly in non-pregnant populations[14, 15]. These findings were supported in studies conducted both domestically and abroad[3, 4, 11, 16, 17].

STATEMENT OF NEED

The gaps in literature point to the need for a more specific examination of the risk factors and comorbid mental health conditions associated with marijuana use during pregnancy in the United States. Currently, the majority of studies have focused on pregnant versus

non-pregnant women of reproductive age (18-44 years) and the socio-demographic risk factors responsible for marijuana use during pregnancy. One study has shown that self-reported poor mental health status was associated with an increased likelihood to consume alcohol during pregnancy[18], but limited research exists investigating the prevalence and determinants of comorbid mental health disorders with marijuana use and marijuana dependence among pregnant women. Moreover, no studies have compared pregnant marijuana users to pregnant non-users in order to specifically focus on the factors influencing pregnant women to use marijuana.

RESEARCH QUESTION & HYPOTHESIS

The purpose of this analysis is to investigate whether an association exists between marijuana use during pregnancy and having serious psychological distress among females of reproductive age in the United States. Additionally, sociodemographic factors, attitudes toward marijuana use, other substance use, and other mental health conditions are also of interest as they may potentially mediate or moderate the main association of interest. The null hypothesis for this analysis is that there is no association between marijuana use during pregnancy and serious psychological distress in the past month among this representative sample of pregnant females aged 18-44 years in the United States population, when controlling for sociodemographic factors and the other correlates mentioned above. The alternative hypothesis is that there is an association between marijuana use during pregnancy and serious psychological distress in the past month among this representative sample of pregnant factors and other females aged 18-44 years in the United States population, when controlling for sociodemographic correlates.

CHAPTER II: LITERATURE REVIEW

This review of relevant literature will develop the context of marijuana use during pregnancy and support the research goals and objectives in order to test the hypothesis of interest. The literature review will first discuss the prevalence and patterns of marijuana use during pregnancy from both a domestic and international perspective. Second, the review will outline the correlates associated with this behavior, categorized by the dynamics of substance use, attitudes, mental health, and other sociodemographic factors. Third, the review will expose the normative nature of comorbid substance use and mental illness and affirm the need to explore the factors influencing marijuana use during pregnancy. Last, the review will outline the fetal outcomes that are resultant of prenatal marijuana exposure and emphasize the short-term and long-term implications for the exposed child.

 For the purpose of effectively communicating the results of this review, the range of terminology referencing marijuana use during pregnancy and relevant time periods around pregnancy and delivery must be established. Table 1 aims to clarify and translate the many variations of pregnancy-related terms used in the following literature review.

Table 1. Definitions for Pregnancy-Related Terminology

Term	Definition
Prenatal	relating to pregnant women and their unborn babies
Antenatal	prenatal; relating to pregnant women and their unborn babies
Perinatal	happening during or around the time of birth
Postpartum	relating to or happening in the period of time following the birth of a child
Maternal Marijuana Use	Use of marijuana specifically during pregnancy

*Medical definitions were utilized where applicable[19, 20]

Given the information noted in the table above, 'marijuana use during pregnancy' is synonymous with 'prenatal marijuana use', 'antenatal marijuana use', and 'maternal marijuana use' when addressing the perspective of the mother. These terms strictly refer to the time period immediately preceding the birth of the child and will be used interchangeably throughout the remainder of this report. 'Prenatal marijuana exposure' and 'antenatal marijuana exposure' can be used to portray the occurrence of marijuana use during pregnancy from the perspective of the exposed fetus or newborn. Dialogue referencing the 'perinatal period' can include time points ranging from before to after birth, but most closely aligns to the time around and during delivery. Lastly, 'postpartum' strictly refers to the time period immediately following the birth of the child and is not directly relevant to the research questions and objectives for this study.

FETAL OUTCOMES

Marijuana use during pregnancy is particularly problematic, due to how prenatal exposure may or may not affect the developing fetus. Given the high rates of comorbid use of other substances with marijuana during pregnancy, it is difficult to differentiate the direct consequences of maternal marijuana use on fetal development[21]. The body of literature on fetal outcomes of prenatal marijuana use is, therefore, quite inconclusive, but worthy of concern when formulating policies on legalization of marijuana use or designing interventions for educational awareness of maternal substance use.

Fetal Growth Parameters

One of the first research studies to investigate pregnancy outcomes of marijuana use indicated that when adjusted for potential confounders, infants whose mothers tested positive for marijuana through urine assays (n=1226) were likely to have a lower birth weight and lower birth length than those whose mothers tested negative for marijuana[22]. These results, in 1989, underlined the potential for impaired fetal growth among infants prenatally exposed to marijuana and the need to utilize biomarkers to validate marijuana use. Conversely, around the same time, a study sample from Canada showed that marijuana use during pregnancy did not negatively affect any of these fetal growth parameters[23]. A decade later, Fergusson et al. (2002) conducted a much larger study (n=12,129) and concluded, again, that prenatal marijuana use does not increase risk for decreased birth length or decreased head circumference, when adjusting for confounding factors [6]. Depending on frequency and length of use during pregnancy, however, prenatal marijuana exposure was shown to produce small, but detectable diminutions in birth

weight[6]. More recent studies conducted in the United States have found that prenatal marijuana use was not significantly correlated with low birth weight, while a large sample (n= 24,874) among Australian women found that prenatal marijuana exposure was significantly correlated with both low birth weight and the fetus being small for gestational age[8, 11, 20].

Preterm Delivery, Perinatal Death, NICU Admissions

Among a large cohort (n=12,129) of pregnant British women studied in 2002, prenatal marijuana use was found to not significantly increase risk for preterm delivery or perinatal death, when adjusting for confounding factors[6]. These results were supported by a smaller, clinic-based cohort (n=396) from Maryland of pregnant women who were predominantly African-American and unmarried, revealing that prenatal marijuana use was not significantly correlated with preterm birth or neonatal intensive care unit (NICU) admissions. Hayatbakhsh et al. (2012) found the opposite effects for both outcomes among a large Australian sample (n=24,874) of pregnant women with a mean age of 28.4 years[8, 11, 24]

Effects on Lactation

Women who use marijuana prenatally are likely to continue use postpartum, into the breastfeeding period. This is supported, in part, by a review reporting that 84% of maternal marijuana users continued use postpartum[25]. A growing body of literature acknowledges that cannabinoids, chemical compounds found in marijuana, are able to reach newborns during breast-feeding, presenting another mechanism of marijuana

exposure for the child[25]. Marijuana use among lactating mothers has been associated with less frequent and shorter feedings for the infant, sedative effects, poor neurodevelopment, and delayed motor development by one year of age[9, 26]. However, due to the high prevalence of women who used marijuana both during pregnancy and lactation, it is difficult to attribute these neurobehavioral deficits solely to marijuana exposure during lactation.

Long-Term Psychiatric, Cognitive, and Substance Use Effects

The most worrisome result of prenatal marijuana exposure is the documented long-term implications for the exposed fetus. Research links this type of exposure to behavioral abnormalities during adolescence, along with increased susceptibility to neuropsychiatric disorders in adulthood[9]. Cognitive development has also been shown to be compromised, as studies show that children who were prenatally exposed to marijuana perform worse on tests of visual-motor coordination, visual analysis, and visual problem solving when compared to the unexposed[10]. Furthermore, in utero exposure to marijuana is also found to be correlated with decreased attention span and behavioral issues, and serves as an independent predictor of marijuana use by 14 years of age[10].

Financial Burden

As documented in this review, prenatal substance use is particularly concerning due to the potential for negative birth outcomes, poor fetal neurodevelopment and long-term behavioral and cognitive deficits for the exposed child. These types of outcomes can then translate into financial burdens on society in the form of prolonged hospital stays for

newborns affected by prenatal marijuana exposure, special education for children with cognitive impairments, or even Child Protective Services having to intervene for cases of child maltreatment due to substance use[5].

EPIDEMIOLOGY OF MARIJUANA USE DURING PREGNANCY

Understanding the trends of marijuana use over time, for both pregnant and non-pregnant females, can help establish the setting for this growing public health issue. National prevalence estimates for marijuana use in the United States population are best reported through the National Surveys on Drug Use and Health (NSDUH).

Past Year Prevalence

Past year marijuana use is defined as the use of marijuana at least once in the last 12 months. Combined[*] NSDUH data from 2007-2012 revealed that between 6-7% of both pregnant and non-pregnant women reported using marijuana in the past year[3]. A study of low-income pregnant women in Sao Paulo, Brazil, indicated a 4.2% past year prevalence specifically for prenatal marijuana use between 2005-2007[16]. Past year marijuana use data may not necessarily overlap with time of pregnancy and cannot provide an accurate account of prenatal marijuana use. However, when compared to past month prevalence, these data allow for indirectly assessing whether women who used marijuana in the past year ceased use once pregnant. This concept will be formulated in the 'Trimester & Duration of Use' section below.

*Average estimates from all NSDUH interviews conducted between 2007 and 2012

Past Month Prevalence

Past month marijuana use, defined by the use of marijuana at least once within the last 30 days, offers a more valid measure of marijuana use concurrent with pregnancy for females who reported being pregnant. Another combined study of NSDUH data from 2002-2006 showed that 2.8% of pregnant women in the United States reported past-month marijuana or hashish use[4]. From 2007-2012, this prevalence rose to 3.9% and in 2013, 4.6% of pregnant women reported past month marijuana use[3, 27]. These NSDUH trend reports demonstrate the increasing trend of past month prenatal marijuana use over the last 15 years in the United States[3].

Prevalence during Pregnancy

Other studies simply acknowledge marijuana use status during time of pregnancy and do not differentiate based on an element of time (i.e., past month, past year). A cohort study collecting data from 2004 – 2008 about consecutive term deliveries in a United States hospital found that 8.4% of these new mothers screened positive, through self-report or urine drug screen, for marijuana use during the perinatal period[20]. Since these data are collected after delivery, positive screens are indicative of marijuana use during the third trimester, but also presumptive of marijuana use during the entirety of pregnancy. Among pregnant women recruited from prenatal and OBGYN clinics in Connecticut, 10.5% were found to report marijuana use during the 1st trimester while 5.4% were found to report marijuana use during the 2nd and 3rd trimesters combined[28, 29]. When compared to the nationally representative NSDUH estimates noted for past month maternal marijuana use, results from these smaller, clinic-based cohort studies seem to generate

much higher prevalence estimates. A keen understanding of the contextual factors and population sampled for these cohort studies might explain these differences and help to more specifically focus on the determinants most predictive of marijuana use during pregnancy.

Global Prevalence

Similar studies conducted outside of North America revealed collectively lower maternal marijuana use when compared to both the nationally representative and cohort-based estimates in the United States. The following are empirical reports for prevalence of prenatal marijuana use in these specified countries: Spain (2.4%), Netherlands (2.9%), Australia (2.6%), and United Kingdom (2.5%) [7, 11, 13, 17]. Conclusions were drawn from cohort studies ranging moderately in methodologies, sample sizes, and study populations, yet demonstrate fairly consistent frequencies for maternal marijuana use abroad.

TRIMESTER AND DURATION OF USE

With pregnancy generally recognized as a critical time for both maternal and fetal health, a decline or cessation of marijuana use during the course of pregnancy highlights a positive incidence in the midst of a concerning issue. Ko et al. (2015) noted that past month maternal marijuana use was lower than past year use (3.9% versus 7.0%) and this decreased prevalence of past month use suggests a plausible, deliberate cessation in marijuana use upon realization of pregnancy status.

Aligned with this occurrence, the 2002-2006 and 2007-2012 NSDUH reports show that

marijuana use in the past month among pregnant women is the highest during the first trimester (4.5%, 3.9%) and declines steadily through the second (2.6%, 2.8%) and third trimester (1.5%, 1.8%) [3, 4]. Blasco-Alonso et al. (2015) echoed this finding on a global scale, as marijuana consumption among pregnant Spanish women notably decreased from 1st trimester (4.8%) to 2nd trimester (1.9%) to 3rd trimester (1.2%) [17].

De Genna et al. (2015) studied trajectories of prenatal marijuana use by measuring marijuana use as a polytomous outcome, categorized as non/unlikely to use (61%), late desistance (15%), decreasing likelihood to use (11%), and increasing likelihood/chronic use (14%) [29]. One hundred percent of those with decreasing likelihood to use reported marijuana use during the first trimester with only 19% reporting use by the third trimester[29].

The Generation R study, conducted in the Netherlands, is a population-based cohort providing longitudinal data of parents and their children, followed from pregnancy. A sub-study, conducted by el Marroun et al. (2008), found that 2.9% of pregnant women reported using marijuana both before and during pregnancy, while only 0.6% continued marijuana use through the entire pregnancy period[13]. Another optimistic finding among these studies is the cessation of marijuana use by the time of delivery. Mark et al. (2015) revealed that out of the 116 patients in their study who screened positive for marijuana use during the first prenatal visit, only three patients tested positive for marijuana at the time of delivery[8].

SOCIODEMOGRAPHIC CORRELATES:

AGE, RACE, EDUCATION, EMPLOYMENT, MARITAL STATUS

Certain correlates were found in the literature to be specific to marijuana use, regardless

of pregnancy status. National estimates from NSDUH 2007-2012 showed that women

who used marijuana in the past month or past year were more likely to be 18-25 years of

age, unemployed, never married, and earn less than $20,000 annually, when compared to

non-users[3]. Among pregnant women, a greater percentage (29.4%) of past month

marijuana users were non-Hispanic African American when compared with pregnant non-

users (12.6%). Conversely, among non-pregnant women, a greater percentage (67.9%) of

past-month users were non-Hispanic white when compared to non-pregnant non-users

(59.0%) [3].

A smaller cohort study from a university-based prenatal clinic in the United States

produced similar findings in terms of correlates associated with marijuana use during

pregnancy. Marijuana use in this study was measured through both self-report and urine

toxicology; an alarming 46.6% of the pregnant patients screened positive for marijuana

use through these measures[8]. This high prevalence coincided with risk factors for

maternal marijuana use noted in the above studies, as this particular patient population

was comprised mainly of females who were African American, unmarried, unemployed,

and less educated[3, 8].

El Marroun et al. (2015) indicated that the same trends were observed in the Netherlands.

Pregnant women using marijuana in the Generation R study were younger, with less

education and less income, not religious, and more likely to be single or unmarried[13].
Similarly, a large sample (n=24,874) in Australia mirrored these results, with women who
reported maternal marijuana use having an increased likelihood of being younger, less
educated, and single[11].

De Genna et al. (2015) specifically studied the role of maternal age as a determinant of
marijuana use during pregnancy[29]. This study found significantly lower maternal age
among those who reported marijuana use during pregnancy when compared to those
categorized as non/unlikely to use marijuana (18.7 years vs. 20.6 years)[29]. Moreover,
pregnant women in this group were more likely to identify as non-white, lending further
support to race as a correlate of marijuana use during pregnancy[29].

A much older study, conducted in 2002 among a large sample of British women,
provided both supporting and contradictory results to the above review. This study also
found that marijuana use during pregnancy was associated with younger maternal age,
however, these women were found to be better educated[6]. The variation in education
serving as a determinant of prenatal marijuana use might stem from the five-category
variable utilized in this study that might not compare well with the educational measures
used in the other studies.

OTHER CORRELATES

Partner Influences

The strongest determinant of prenatal marijuana use found in the Generation R study was

marijuana use by the biological father of the child (OR=4.25; 95%CI=2.33–7.75)[13].

These romantic partner influences were also supported through the research of Desrosiers et al (2015), who found male partner marijuana use during the prenatal period significantly predictive of female partner marijuana use in the postnatal period[28]. This might be explained by the susceptibility of expecting or newly parenting mothers to match their partners' substance use patterns in order to maintain relationship commitment and satisfaction, especially in anticipation of raising a child together[28].

Attitudes toward Marijuana Use

The combined 2007-2012 NSDUH report illustrated how perceived risk of using marijuana served as an inverse indicator of maternal marijuana use[3]. Risk of using marijuana once or twice or week was categorized as no risk, slight risk, moderate risk, and great risk. Both non-pregnant and pregnant marijuana users were significantly more likely to perceive no risk or slight risk in using marijuana[3]. Considering attitudes toward marijuana use, and even more distinctively, attitudes toward marijuana use during pregnancy, can help provide a more thorough context to use when pregnant.

Other Substance Use

Pregnant women in both the United States and the United Kingdom who reported using marijuana in the past month were also more likely to have smoked tobacco in the past month, have heavy or binge alcohol use in the past month, or use other illicit drugs in the past month[3, 6, 8]. The most noteworthy of the three substance use categories is that pregnant women in the United States were significantly more likely to report current or

ever use of tobacco (OR=3.3; 95 % CI: 1.9–5.9) when compared to pregnant non-users[8].
Shu et al. (2015) found an even more intensified association in their low-income
Brazilian study population, as the odds of active tobacco smoking in pregnant marijuana
users was 6.89 times the odds in pregnant marijuana non-users (95 % CI 3.45–13.8)[16].
The comorbid use of both marijuana and tobacco is again demonstrated through the work
of el Marroun et al. (2008) and Conner et al. (2015), as they found that 54.4% and 58.1%,
respectively, of those using marijuana during pregnancy were also smoking tobacco[13, 20].

In documenting how other comorbid substance use persists throughout the course of
pregnancy, De Genna et al. (2015) reported that pregnant women using marijuana,
compared to marijuana non-users, were significantly more likely to also use tobacco
and/or alcohol in both the first and third trimesters[29]. In fact, comorbid tobacco use
actually increased over the course of pregnancy, from first to third trimester (67% to
75%) [29].

Mental Illness & Other Trauma

Data collected from a prenatal clinic in the United States showed that pregnant marijuana
users were more likely to report depressed mood and a history of sexual or physical abuse
than pregnant non-users[8]. Moreover, a greater percentage of pregnant women who
screened positive for marijuana use had a psychiatric diagnosis (21.9%) compared to
those who screened negative (14.3%), although the difference was not significant
(p=0.064)[8]. When studying the trajectories of cannabis use, maternal marijuana use was
significantly associated with reporting depression and hostility 6 – 16 years post

partum[29]. The estimates for chronic depression, even when adjusted for maternal age, remained highly significant among pregnant marijuana users and implicate the influential role of depressive symptoms in serving as a correlate of maternal marijuana use[29].

Common mental disorder (CMD) was also shown to be a significant independent correlate of maternal marijuana use among low-income, pregnant women in Brazil (OR=3.3, 95 % CI 1.65–6.59)[16]. This mental illness diagnosis was achieved through the use of the self-report questionnaire-20 (SRQ-20) to identify common mental disorders during the antenatal time period[16].

Overall, there has been very little research conducted to investigate the associations between maternal marijuana use and comorbid mental health conditions. The measures utilized to diagnose the mental disorders are seldom disclosed and point to the lack of validated research.

COMORBID MARIJUANA USE & MENTAL ILLNESS

More generally, marijuana use has been shown to be associated with a range of mental health-related outcomes, regardless of pregnancy status. A fairly large sample (n=3169) belonging to a Dutch cohort of patients with severe mental illness was examined for potential correlations between marijuana use and mental health at baseline and follow – up assessments[14]. The findings showed that at baseline, marijuana users were more likely to have severe psychotic symptoms when compared to non-users[14]. Psychiatric diagnoses were reported by the patient and later verified by the patient's psychiatrist in the medical

record, while marijuana use and frequency were collected only by self-report[14]. This study specifically underlined the increased likelihood of marijuana use to be associated with comorbid schizophrenia (p=0.005) or depressive disorder (p=0.011)[14]. Most interestingly, the follow-up assessment conducted between 9 and 24 months after baseline assessment, revealed that marijuana discontinuers enjoyed a significant reduction in psychotic symptom severity compared both to continuers and marijuana non-users[14].

Contrastingly, a nationally representative sample of the United States was interviewed with the National Epidemiologic Survey on Alcohol and Related Conditions and featured a dissimilar list of correlated mental disorders with marijuana use. Among past year marijuana users, social anxiety disorder was found to be a significant predictor of use compared to non-users (OR=1.8, 95% CI: 1.1 – 2.8), while bipolar I disorder was the next most significant predictor (OR=1.4, 95% CI: 1.0-2.1)[15]. The longitudinal nature of this study allowed for the data to be analyzed at two time points (wave 1 & wave 2) marking a time span of three years. The follow-up assessment at wave 2 revealed that the prevalence of any mental disorder tended to increase with the intensity of exposure to marijuana at wave 1. Specifically, increasing marijuana intake from 0 to 1 joints per day caused the greatest increase in prevalence of any mental disorder at wave 2[15].

CURRENT PROBLEM & STUDY RELEVANCE

The above literature review documents the increasing prevalence of marijuana use nationally over the past few decades, and by extension, the simultaneous increase in marijuana use among pregnant women. The occurrence of maternal marijuana use has

been shown to be confounded by a variety of sociodemographic factors (i.e., age, race, income, marital status), and mediated by attitudes toward marijuana use as well as the comorbid use of other substances, most notably, tobacco. Comorbid mental health conditions, specifically depression and anxiety, were also presented as prevailing features of general marijuana use.

Limited research has explored how mental health conditions may serve as risk factors for marijuana use during pregnancy. Moreover, most of the body of literature presented compares pregnant women to non-pregnant women, and does not allow for a focus on the complex nature of risk factors prevalent in the pregnant population. Therefore, addressing the gaps in research for the risk factors for prenatal marijuana use necessitates a concentrated assessment of the pregnant population and an investigation of the most significant mental health (specifically, psychological distress), substance use, attitudinal, and sociodemographic predictors for this outcome. The conclusions derived from this analysis will have implications for both the mother and prenatally exposed fetus and fuel further research and policies aimed at better understanding and protecting the health outcomes consequent of marijuana use during pregnancy.

CHAPTER III: METHODOLOGY

RESEARCH DESIGN

This is a cross-sectional, correlational analysis of publicly available data from the

National Survey on Drug Use and Health (NSDUH). Specifically, this exploratory

research focuses on questions and data from the 2014 NSDUH survey that are related to

past-month marijuana use (main outcome variable), past month serious psychological

distress (independent variable), and covariates that potentially moderate, mediate, or

confound this relationship among pregnant females aged 18-44 years of age.

OVERVIEW OF NATIONAL SURVEY ON DRUG USE AND HEALTH

The NSDUH, sponsored by the Substance Abuse and Mental Health Services

Administration (SAMHSA), U.S. Department of Health and Human Services, is a

national survey of the civilian, noninstitutionalized population of the United States aged

12 years or older[30]. Administered on an annual basis, the NSDUH serves as the primary

source of statistical information for the United States population's use of alcohol,

tobacco, and illicit drugs[30]. The survey additionally inquires about mental health

conditions and collects data focused on a range of psychological diagnoses. Individuals

with no fixed residential address or those residing in correctional facilities, hospitals, or

other institutional group quarters, are excluded from NSDUH, along with active-duty

military service members[30].

Since 1971, this survey has been directed through the federal government's efforts to

collect substance abuse and mental health data through face-to-face interviews with a

representative sample of the national population[30]. The interviews are conducted at the respondent's place of residence and the data is collected and analyzed under contract with RTI International (Research Triangle Park, North Carolina) [30]. The survey, as a whole, is planned and managed by SAMHSA'S Center for Behavioral Health Statistics and Quality (CBHSQ) [30]. CBHSQ utilizes the Substance Abuse and Mental Health Data Archive (SAMHDA) at http://www.datafiles.samhsa.gov to make NSDUH a publicly available data resource[30].

TARGET POPULATION AND SAMPLE

The NSDUH is designed to describe the substance abuse and mental health prevalence estimates in the United States based on the target population of the civilian, noninstitutionalized population aged 12 years or older residing in the United States. This target population is expected to include at least 97 percent of the total population of individuals aged 12 or older in the United States[30]. The 2014 NSDUH survey results were comprised of 67,901 completed interviews, with an overall response rate of 58.3%[2].

In order to achieve a representative sample of the national population, a coordinated survey design was developed employing multistage area probability samples taken within each state and the District of Columbia[30]. Each state was then divided into regions of approximately equal population sizes, referred to as the state sampling regions (SSRs) [30]. Multistage area probability sampling was then feasible through a 4-stage sampling design applied to each SSR: 1) selecting census tracts within each SSR, 2) selecting census block groups within each census tract, 3) selecting area segments within each census

block group, and 4) selecting dwelling units within each area segment[30]. Within each

dwelling unit, no more than two residents who were at least 12 years or older were

selected for the NSDUH interview[30]. A modified design was newly introduced for the

2014-2017 NSDUHs, as more interviews were assigned to the twelve largest U.S. states,

making the 2014 sample size more proportional to the state population size[30]. This

change helped improve precision of the national estimates and also allowed for a more

cost-efficient method of allocating the survey sample[30].

This particular study focused only on the pregnant female population of the United States

aged 12 years or older. Restricting the population to include only respondents who were

pregnant produced an unweighted sample of 758 respondents (1.37% of the surveyed

population) and weighted sample of 2,326,773 people. This population of pregnant

females fell into an age range of 12 to 44 years. The target population for this particular

study was, therefore, redefined as the civilian, noninstitutionalized, population of

pregnant females in the United States aged 12 – 44 years.

INSTRUMENT AND DATA COLLECTION

The NSDUH data collection strategy incorporates various procedures to allow the in-

person interviews to foster cooperation between the respondent and interviewer. A

computer-assisted interviewing (CAI) method is employed to encourage the sampled

individual to report honestly about sensitive topics such as mental health issues or illegal

use of drugs in a setting that is both private and confidential[30]. Moreover, confidentially

is emphasized during all aspects of written or oral communications and respondent names

are not collected during the data collection process[30].

The NSDUH interview has both English and Spanish versions with identical content [30]. If the sampled individual prefers to complete the interview in Spanish, a certified bilingual NSDUH interviewer is assigned to the person's address to conduct the interview[30]. However, the NSDUH is not conducted in any household where the sampled individual does not speak English or Spanish[30].

Completing the interview takes about an hour, on average, and is conducted in a private space in the respondent's home, away from other members of the household[30]. NSDUH utilizes both computer-assisted personal interviewing (CAPI) and audio computer-assisted self-interviewing (ACASI) techniques to conduct the interview[30]. For the CAPI portion, the field interviewer is responsible for reading the questions aloud to the respondent and recording the answers, while in the ACASI portion, the respondent independently reads or listens to the questions presented on the screen or through headphones[30]. The respondent then records his or her response without the interviewer having any knowledge of the response[30].

The NSDUH interview is divided into core and supplemental sections. Core questions are presented at the beginning of the interview and consist of interviewer-administered items related to demographics and self-administered items pertaining to the use of alcohol, tobacco, or illicit use of substances (i.e. marijuana, cocaine, crack cocaine, heroin, hallucinogens, inhalants, pain relievers, tranquilizers, stimulants, and sedatives) [30].

Answers from the core questions, which remain in the survey every year, are fundamental in generating the basic trend measurements of prevalence estimates for substance abuse[30]. The supplemental sections, or noncore questions, can be revised, added, or dropped any given year and contain the remainder of the NSDUH interview[30]. Supplemental questions that are self-administered focus on mental illness and utilization of mental health services, along with additional topics such as injection drug use, perceived risks of using substances, substance dependence or abuse, treatment for substance use problems, pregnancy, arrests, and other relevant health care issues[30]. Interviewer-administered questions in this noncore section address topics such as employment and workplace issues, health insurance coverage, immigration, school enrollment, and income[30].

Respondents are incentivized to complete the full interview with $30 cash, given to acknowledge and show gratitude for his or her time[30]. For the 2014 NSDUH survey, the overall weighted response rate was 58.3%, and signifies the product of the weighted screening response rate and the weighted interview response rate[30].

Checks for consistency and editing are conducted through the CAI program during the interview, however, RTI International also completes additional, more complex cleaning and accuracy safeguards[30]. Key variables that display missing or ambiguous values undergo statistical imputation to replace the omissions[30]. Additionally, analysis weight variables are created in order that estimates be representative of the target population[30]. Details of the editing, imputation, and weighting methods for the 2014 survey can be found in the *2014 NSDUH Methodological Resource Book*[30].

DATA RETRIEVAL

For this particular study, the complete 2014 NSDUH dataset was downloaded from the SAMHDA website in SAS format. SAS software was used to modify the NSDUH dataset and account for the complex survey design through specialized SAS procedures (e.g. SURVEYLOGISTIC, SURVEYFREQ). (Appendix IV)

LIMITATIONS

1. The target population for this study excluded certain subpopulations (i.e. Active-duty military personnel, individuals living in institutional group quarters or with no fixed address)[30]. People identifying or residing within these subpopulations may actually display significantly different estimates for mental disorders and substance use and, consequently, have specific needs not captured by the current inclusion criteria[30].

2. The cross-sectional design of the study limits explanations for directionality, based on confirmed associations between the outcome and independent variables. As exploratory research, the results of the study only provide descriptive and inferential information that cannot speak to causality in the study effect estimates.

3. The self-reported nature of NSDUH data is prone to underreporting through social desirability bias as responses are likely to be influenced by negative perceptions of use during pregnancy, regardless of procedures put in place to protect respondent confidentiality and privacy. Moreover, variables collecting

information on mental health conditions are not easily measured or validated, and

therefore, are subject to misclassification within the data.

DELIMITATION

1. Respondents who were between 12-17 years of age represented a very small

   percentage (1.4%) of pregnant marijuana non-users. This age category was,

   therefore, excluded during regression analysis, in order to prevent sparse data bias

   from influencing the final effect estimates.

DATA SELECTION AND VARIABLE CODING

All variables in the NSDUH 2014 survey were created and coded by RTI International

and were generated directly through the interview items[30]. The 2014 National Survey on

Drug Use and Health Codebook provides information regarding variable names,

descriptions, codes, code meanings, and the unweighted univariate frequency

distributions for each variable[31].

The text and tables below serve as a guide to the selected variables of interest, informed

by associations noted in the literature.

Target Population Variable

Pregnancy status. The respondent's pregnancy status was measured through the

dichotomous PREG variable (see Table 2). This allowed for the restriction of the study

population to include only the pregnant respondents (PREG=1) who were of interest in

answering the research question.

Table 2. Codes for Main Variables of Interest

Variable	Measure	Code	Value
PREG	Pregnant Females Aged 12 - 44	0	Otherwise
		1	Pregnant Females Aged 12-44
MRJMON	Marijuana Use - Past Month	0*	Did not use in the past month
		1	Used within the past month
SPDMON	Past Month Serious Psych Distress Indicator	0*	No
		1	Yes

*Reference group

Outcome Variable

Past month marijuana use. The outcome variable, marijuana use in the past month, was

measured with the MRJMON variable through the following question: 'Did you use

marijuana or hashish during the past 30 days?' (See Table 2).

Independent Variable

Past month serious psychological distress. The independent variable of interest, past

month serious psychological distress, was measured through the Kessler6 (K6) scale and

coded into the SPDMON variable (see Table 2). The K6 is a 6-item scale that asks adult

respondents (>17 years old) how frequently they experienced symptoms of psychological

distress during the past 30 days. The sum of the K6 scale can range from 0-24 and this

value is used to create the SPDMON variable that is coded "1" for "yes, past month

serious psychological distress" (K6 value>=13), "0" for "no past month serious

psychological distress" (K6 value <13), or "." for missing, due to respondent being

between 12-17 years old. Missing values were excluded from this analysis.

Mediating Variables

Trimester. Table 3 presents codes for the pregnancy-related variable, trimester of

pregnancy.

Table 3. Codes for Pregnancy-Related Variable

Variable	Measure	Code	Value
TRIMEST	Current Trimester of Pregnancy – Females Aged 12 - 44	1[*]	1st 3 Months of Pregnancy
		2	2nd 3 Months of Pregnancy
		3	Last 3 Months of Pregnancy

[*]Reference group

Substance use variables. Marijuana dependence in the past year (DEPNDMRJ) and

nicotine dependence in the past month (DNICNSP) was defined according to DSM-IV

criteria (see Table 4). Marijuana Past Month Frequency of Use was recoded from RTI's

original continuous coding (IRMJFM) into a 3-level categorical variable, IRMJFM_C,

indicating ranges of frequency of use in a month. This variable was only applicable to

respondents who responded "yes" to past month marijuana use.

Table 4. Codes for Substance Use Variables

Variable	Measure	Code	Value
DEPNDMRJ	Marijuana Dependence in the Past Year	0[*]	No/Unknown
		1	Yes
IRMJFM_C	Marijuana - Past Month Frequency of Use	1	1 - 10 times a month
		2	11-20 times a month
		3	21-30 times a month
CIGYR	Cigarettes - Past Year Use	0[*]	Did not use in the past year
		1	Used within the past year
CIGMON	Cigarettes - Past Month Use	0[*]	Did not use in the past month
		1	Used within the past month
DNICNSP	Nicotine Dependence in the Past Month	0[*]	No
		1	Yes

[*]Reference group

Attitudes toward using marijuana. As shown in Table 5, two variables captured the

respondent's perceived risk in smoking marijuana once a month (RSKMJOCC) or once

or twice a week (RSKMJREG). Due to sparse data for value 4 - "great risk" - this

variable was recoded during the logistic regression so that levels 3 and 4 were combined

into a single category, a new level 3, comprising both "moderate risk and great risk"

responses. The attitudinal variables also included attitudes toward religious beliefs.

Table 5. Codes for Attitudinal Variables

Variable	Measure	Code	Value
RSKMJOCC	Risk Smoking Marijuana Once a Month	1*	No risk
		2	Slight risk
		3	Moderate risk
		4	Great risk
RSKMJREG	Risk Smoking Marijuana Once or Twice a Week	1*	No risk
		2	Slight risk
		3	Moderate risk
		4	Great risk
SNRLGIMP	My Religious Beliefs are Very Important	1*	Strongly disagree
		2	Disagree
		3	Agree
		4	Strongly agree

*Reference group

Mental health variables. Table 6 lists the variables reporting on diagnoses for anxiety or depression in the past year or during lifetime (ANXDYR, ANXDLIF, DEPRSYR, and DEPRSLIF). These measures were based on whether a doctor or other medical professional had notified the respondent that she had a specific mental health condition. Serious psychological distress in the past year (SPDYR) was measured through the same K6 scale used to measure serious psychological distress in the past month, noted in the 'Independent Variable' section and Table 2. The categorical mental illness indicator (MI_CAT_U) was created through a complex system of measures utilized in the 2008 NSDUH prediction model for mental illness. Specific details for how each of the levels were coded can be found in the 2014 Recoded Mental Health Module Variable Documentation Appendix[32].

Table 6. Codes for Mental Health Variables

Variable	Measure	Code	Value
ANXDYR	Had Anxiety in Past Year	0[*]	No
		1	Yes
ANXDLIF	Had Anxiety in Lifetime	0[*]	No
		1	Yes
DEPRSYR	Had Depression in Past Year	0[*]	No
		1	Yes
DEPRSLIF	Had Depression in Lifetime	0[*]	No
		1	Yes
SPDYR	Past Year Serious Psych Distress Indicator	0[*]	No
		1	Yes
MI_CAT_U	Categorical Mental Illness (MI) Indicator	0[*]	No Past Year MI
		1	Past Year Mild MI
		2	Past Year Moderate MI
		3	Past Year Serious MI

[*]Reference group

Confounding Variables

Age. The age variable is presented in Table 7. For the logistic regression portion of the analysis, there were too few data points for respondents aged 12-17 years and this response category was therefore excluded from the analysis. Category 2, ages 18-25 years, was therefore used as the reference group for the analysis.

Table 7. Codes for Sociodemographic Variables

Variable	Measure	Code	Value
CATAGE	Age Category	1	12-17 Years Old
		2*	18-25 Years Old
		3	26-34 Years Old
		4	35 - 44 Years Old
IRMARIT	Marital Status	1	Married
		3	Divorced or Separated
		4	Never Been Married
NEWRACE2	Race/Hispanicity	1	NonHisp White
		2	NonHisp Black/Afr Am
		3	NonHisp Native Am/AK Native
		4	NonHisp Native HI/Other Pac Isl
		5	NonHisp Asian
		6	NonHisp more than one race
		7	Hispanic
RACE	Race/Hispanicity Recode	1	NonHisp White
		2	NonHisp Black/Afr Am
		3	Hispanic
		4	Other (NEWRACE2=3-6)
INCOME	Total Family Income	1	Less than $20,000
		2	$20,000 - $49,999
		3	$50,000 - $74,999
		4	$75,000 or More

*Reference group

Race/Hispanicity. Race/ Hispanicity is also presented in Table 7. The race/Hispanicity of

the respondent was measured through a 7-level variable called NEWRACE2. Due to

sparse data for levels 4 and 5, race/ethnicity was recoded into a 4-level variable, RACE,

for the regression analysis.

DATA ANALYSIS PROCEDURES

Descriptives. Descriptive procedures and weighted frequencies were calculated using

standard SAS software and the specialized procedures for the complex survey design

(i.e., PROC SURVEYFREQ). All variables were either dichotomous or categorical, ranging from 2 – 7 categories. Weighted frequencies, percentages, and 95% confidence intervals were calculated for the independent variable and all covariates, stratified by outcome.

Diagnostics

Excluding the outcome and independent variables, a total of 19 potential correlates were of interest in this analysis.

Bivariate frequencies. Simple bivariate cross tabulations between the outcome (past month marijuana use) and the correlate of interest revealed, expectedly, that for the marijuana past month frequency of use variable, no data were available for responders who identified as marijuana non-users. This correlate was therefore eliminated from the final model.

Collinearity. Multicollinearity among the independent variable and the remaining 18 correlates were first evaluated through a collinearity assessment. Interaction terms involving the independent variable, past month serious psychological distress, and 8 correlates of interest were also included in the full model. Due to the large number of variables in the model, a forward selection method was first utilized to monitor the condition index values from the basic outcome-independent variable model with the addition of every correlate to the model. This was followed by a backwards elimination method to reassess potentially collinear variables. A SAS macro for SURVEYLOGISTIC

had to be performed in order to adequately check for collinearity within a complex survey design such as the NSDUH (Appendix IV). Condition indices greater than 30 with at least two VDP values greater than 0.5 were considered to signify a potentially collinear relationship. In such an instance, a single correlate or interaction term would be dropped and the collinearity procedure would be repeated until a model was reached that produced a condition index of less than 30. A reduced model of the independent variable, 11 correlates, and one interaction term was reached that indicated no further complications with collinearity.

Primary variables. Before proceeding with the analysis, five variables were designated, *a priori,* informed by the literature, as correlates of primary interest and, therefore, not considered eligible to be eliminated from the final reduced model. These variables were: trimester, age, perceived risk of smoking marijuana 1-2x a week, past month cigarette use, and past year depression.

Significance testing. The reduced model then underwent backwards elimination through significance testing and dropping of correlates or interaction terms with p-values of greater than 0.05, starting with the greatest p-value. The model was further reduced until no variables remained that were not significant predictors or were not among the five correlates of primary interest. The final reduced model included the independent variable of interest and the five primary correlates of interest, as all other correlates and interaction terms were removed from the model through the collinearity or significance testing backwards elimination procedures.

Confounding assessment. Although the reduced model had no variables eligible for elimination based on the *a priori* statement, a confounding assessment was conducted to confirm that removal of the included variables might actually confound the relationship between the outcome and the independent variable. This result was endorsed, as dropping any one correlate from the model resulted in a greater than 10% change in the estimate from the original model.

Multivariate logistic regression. Multivariate logistic regression was performed to quantify the associations between the outcome variable, past month marijuana use, and the main independent variable, past month serious psychological distress, controlling for the other five covariates in the final model.

As recommended for NSDUH data, programmatic procedures that accommodate the study design and complex survey methods (i.e., PROC SURVEYLOGISTIC) were used to analyze this data, including the use of analytic procedures that accommodate the weights associated with each observation specific to the NSDUH 2014 dataset. All SAS programs and a detailed guide to the analysis procedure can be found in the Appendix IV and II, respectively.

IRB CLEARANCE

Analysis performed in completion of this thesis involved secondary analysis of a public-access, de-identified, national dataset. As a result, the analysis was exempt from Approval by the Institutional Review Board (IRB) of Emory University.

CHAPTER IV: RESULTS

STUDY POPULATION

This analysis was undertaken with NSDUH 2014 data from 758 total respondents who reported being pregnant and were between the ages of 12-44 years. As a nationally representative survey, this study sample generated a total weighted pregnant population of 2,326,773 females aged 12-44 years.

Since the outcome variable of interest was marijuana use in the past month, all results will be presented stratified by marijuana users versus non-users. Among this weighted study population, 4.5% (weighted n=103,582) of pregnant women aged 12-44 years reported using marijuana in the past month. (Table 8, Appendix III).

MENTAL HEALTH CHARACTERISTICS STRATIFIED BY OUTCOME

Psychological Distress. Only 3.9% (weighted n=85,028) of pregnant marijuana non-users reported having serious psychological distress in the past month whereas 11.2% (weighted n=245,214) reported having serious psychological distress in the past year. Contrastingly, a third (33.0%, weighted n=31,276) of pregnant marijuana users reported having serious psychological distress in the past month while half (50.6%, weighted n=47,954) reported serious psychological distress in the past year (Table 12, Appendix III).

Mental Illness Severity. Pregnant marijuana non-users primarily reported having no mental illness in the past year (82.8%, weighted n=1,816,079) with only 2.3% (weighted

n=49,526) reporting serious mental illness in the past year. About half (52.2%, weighted n=49,485) of pregnant marijuana users reported having no mental illness in the past year while more than a third (36.5%, weighted n=34,526) reported having a serious mental illness in the past year (Table 12, Appendix III).

Depression/Anxiety. Diagnoses of depression in the past year or in lifetime were much more prevalent in pregnant marijuana users (36.1% and 43.7%, respectively) than pregnant marijuana non-users (6.5% and 14.8%, respectively). Similarly, differences were noted in diagnoses of anxiety in past year and lifetime among pregnant marijuana users (26.9% and 28.4%, respectively) compared to pregnant marijuana non-users (5.7% and 11.0%, respectively; Table 12, Appendix III).

SOCIODEMOGRAPHIC CHARACTERISTICS STRATIFIED BY OUTCOME

Age. Among pregnant marijuana non-users, about half (50.7%, weighted n=1,127,035) were between 26-34 years of age while the majority (65.8%, weighted n=68,120) of pregnant marijuana users were between 18-25 years of age. Only 1.4% of pregnant marijuana non-users (weighted n=30,547) were 12-17 years old compared to 8.6% (weighted n=8,866) of pregnant marijuana users (Table 9, Appendix III).

Race/Hispanicity. Among pregnant marijuana non-users, 55.8% (weighted n=1,241,329) identified as non-Hispanic White, followed by 18.0% (weighted n=400,068) who identified as Hispanic, and 14.0% (weighted n=310,871) who identified as non-Hispanic

black/African American. These trends were mostly maintained among pregnant marijuana users as the majority (60.6%, weighted n=62,805) still identified as non-Hispanic white, while the next two most prevalent ethnic groups were Hispanic (18.1%, weighted n=18,710) and non-Hispanic black/African American (17.6%, weighted n=18,240; Table 9, Appendix III).

Total Family Income. Distributions for total family income among pregnant marijuana non-users were mostly uniform, with the greatest proportion of women (34.1%, weighted n=758,730) reporting income of more than $75,000 per year. Contrastingly, 75.3% of pregnant marijuana users had incomes less than $50,000 (Table 9, Appendix III).

Marital Status. Most pregnant marijuana non-users were married (61.5%, weighted n=1,364,260) while a considerable number never had been married (33.0%, weighted n=730,927). Pregnant marijuana users, however, had predominantly never been married (90.7%, weighted n=93,988; Table 9, Appendix III).

TRIMESTER STRATIFIED BY OUTCOME

Pregnant marijuana non-users were uniformly represented across trimesters with approximately one third (29.4%, 37.0%, 33.6%) being in their first, second, or third trimester of pregnancy, respectively. Among pregnant marijuana users, 61.1% (weighted n=63,247) were in the first trimester, 30.2% (weighted n=31,285) in the second trimester, and 8.7% (weighted n=9,050) in the third trimester (Table 10, Appendix III).

SUBSTANCE USE CHARACTERISTICS STRATIFIED BY OUTCOME

Marijuana. Among pregnant marijuana users, 6.6% (weighted n=6,789) met criteria for

marijuana dependence in the past year with the majority (67.1%, weighted n=69,484)

reporting marijuana use one to ten times in the past month (Table 11, Appendix III).

Cigarette/Nicotine. Pregnant marijuana non-users primarily reported not using cigarettes

in the past month (90.3%, weighted n=2,006,502) or the past year (79.5%, weighted

n=1,767,542). Conversely, pregnant marijuana users had a 66.3% (weighted n=68,628)

prevalence of cigarette use in the past month and 80.7% (weighted n=83,609) of cigarette

use in the past year. In parallel to this result, 44.8% (weighted n=46,410) of pregnant

marijuana users also met criteria for nicotine dependence in the past month compared to

only 4.4% (weighted n=96,876) of pregnant marijuana non-users who met criteria for

nicotine dependence. (Table 11, Appendix III)

ATTITUDES STRATIFIED BY OUTCOME

Risk of Smoking Marijuana. Among pregnant marijuana non-users, 79.5% (weighted

n=1,740,182) perceived slight, moderate, or great risk in smoking marijuana once a

month while the majority (55.9%, weighted n=57,928) of pregnant marijuana users

perceived no risk. Identical trends among pregnant marijuana users and non-users were

observed for perceived risk of smoking marijuana once or twice a week (Table 13,

Appendix III).

Religious Beliefs. Pregnant marijuana non-users primarily agreed or strongly agreed that

religious beliefs were important (76.4%, n=1,623,188) while only 57.6% (n=53,418) of pregnant marijuana users agreed or strongly agreed that religious beliefs were important (Table 13, Appendix III).

MULTIPLE LOGISTIC REGRESSION ANALYSIS

In order to examine the association between marijuana use in the past month and serious psychological distress in the past month among pregnant women, a multiple logistic regression analysis was conducted. Incorporating all the sociodemographic, pregnancy, mental health, substance use, and attitude-related correlates of interest created the following original, full model:

Full model:

$OR_{\text{past month marijuana use}} = \beta_{\text{past month serious psych distress}} + \beta_{\text{age}} + \beta_{\text{race/Hispanicity}} + \beta_{\text{income}} + \beta_{\text{marital status}}$

$+ \beta_{\text{trimester}} + \beta_{\text{past month cigarette use}} + \beta_{\text{past year cigarette use}} + \beta_{\text{past month nicotine dependence}} + \beta_{\text{past year serious psych distress}} + \beta_{\text{past year mental illness indicator}} + \beta_{\text{past year depression}} + \beta_{\text{lifetime depression}} + \beta_{\text{past year anxiety}} +$

$\beta_{\text{lifetime anxiety}} + \beta_{\text{perceived risk smoking marijuana 1x month}} + \beta_{\text{perceived risk smoking marijuana 1/2x week}} + \beta_{\text{religious beliefs}} + \beta_{\text{past year serious psych distress* age}} + \beta_{\text{past year serious psych distress* marital status}} + \beta_{\text{past year serious psych distress* income}} + \beta_{\text{past year serious psych distress* perceived risk smoking marijuana 1/2x week}} + \beta_{\text{past year serious psych distress* perceived risk smoking marijuana 1x month}} + \beta_{\text{past year serious psych distress* past year depression}} + \beta_{\text{past year serious psych distress* past year anxiety}} + \beta_{\text{past year serious psych distress* past year mental illness indicator}}$

Multicollinearity assessment and the backward stepwise elimination method based on test of significance (p>0.05) were used to eliminate collinear and non-significant correlates,

respectively, from the model. Detailed results from these procedures can be found in Appendix II.

The final reduced model examined the association between marijuana use in the past month and serious psychological distress in the past month among pregnant women aged 18-44 years, adjusting for trimester of pregnancy, age, perceived risk of smoking marijuana once or twice a week, cigarette use in the past month and depression in the past year.

Final (reduced) model:

$OR_{\text{past month marijuana use}} = \beta_{\text{past month serious psych distress}} + \beta_{\text{trimester}} + \beta_{\text{age}} + \beta_{\text{perceived risk smoking marijuana}}$

$_{\text{1/2x week}} + \beta_{\text{past month cigarette use}} + \beta_{\text{past year depression}}$

When adjusting for all other variables in the reduced model, pregnant women who had serious psychological distress in the past month had increased odds of using marijuana in the past month (OR=6.667, 95% CI: 1.148 – 38.707). Trimester of pregnancy was also found to be significantly correlated with odds of marijuana use in the past month among pregnant women, with those in the second trimester (OR=0.109, 95% CI: 0.108 – 0.903) and third trimester (OR=0.059, 95% CI: 0.013 - 0.275) of pregnancy having decreased odds of marijuana use in the past month when compared to those in the first trimester of pregnancy. Pregnant women aged 26-34 years had significantly decreased odds (OR=0.109, 95% CI: 0.026 – 0.446) of marijuana use in the past month when compared to those aged 18-25 years. Perceived risk of marijuana use also produced a protective

effect as pregnant women who perceived moderate or great risk of smoking marijuana once or twice a week had significantly decreased odds (OR=0.102, 95% CI: 0.026 – 0.393) of marijuana use in the past month. Cigarette use in the past month was the most significant correlate (p<0.0001) of marijuana use in the past month among pregnant women (OR=12.443, 95% CI: 3.822 – 40.512). Depression in the past year was not found to significantly increase odds of marijuana use in the past month among pregnant women (OR=2.936, 95% CI: 0.676 – 12.753; Table 14, Appendix III).

CHAPTER V: DISCUSSION

The primary objective of this research study was to investigate whether an association

exists between marijuana use during pregnancy and having serious psychological

distress, among females aged 18-44 years in the United States. By restricting the study

population to only pregnant women, this analysis specifically addressed the correlates for

maternal marijuana use.

Overall Prevalence of Maternal Marijuana Use

The results of this thesis, based on the 2014 NSDUH, estimated that 4.5% (95% CI: 2.8 -

6.2) of pregnant women aged 18-44 years in the United States used marijuana in the past

month. This was aligned with the NSDUH 2013 estimate of 4.6% and underscores how

maternal marijuana use continues to be a concern, especially given the increasing trend in

use over the last 15 years[3, 4, 27]. Taking into consideration the established comorbidity

between substance use and mental illness, investigating the effect of mental illness on

marijuana use, specifically during pregnancy, was the desired next step.

Association between Maternal Marijuana Use and Serious Psychological Distress

The main independent variable of interest, serious psychological distress in the past

month, was associated with a significant increase in the odds of maternal marijuana use

in the past month (OR=6.667, 95% CI: 1.148 – 38.707), when adjusting for the other

correlates in the reduced model. The findings from this research, consequently, reject the

null hypothesis and indicate that serious psychological distress in the past month is

significantly correlated with prenatal marijuana use. Serious psychological distress in the

past month was measured through a Kessler6 (K6) scale covering the breadth of

symptoms related to feeling nervous, depressed, hopeless, restless, and worthless.

Although not a DSM-IV endorsed method of diagnosing psychiatric disorders, this

measure utilizes a comprehensive method of capturing a range of general mental distress

symptoms. The results of this analysis are aligned with previous studies conducted both

domestically and abroad, which draw associations between prenatal marijuana use and

common mental disorders (CMD), depressive symptoms, social anxiety disorder, and

schizophrenia in the mother[8, 16, 29]. This thesis goes further than the existent literature to

demonstrate how a range of common mental distress symptoms, even without clinical

bearing, are collectively comorbid with marijuana use during pregnancy[14, 15]. Serious

psychological distress in the past month was found among a striking 33.0% of pregnant

marijuana users compared to only 3.9% of pregnant marijuana non-users. The estimates

presented in this analysis point to the magnitude of psychological distress afflicting

pregnant women using marijuana and may serve as an indication of the magnitude of

clinically diagnosed mental disorders in this population. Regardless of classification as a

formal psychiatric disorder, the widespread nature of distress among pregnant marijuana

users warrants concern and consideration of effective strategies for psychological relief,

especially during the characteristically stressful period of pregnancy.

Association between Maternal Marijuana Use and Depression in Past Year

Recognizing that the more inclusive serious psychological distress variable includes some

symptoms of depression, our regression model went further to differentiate the specific

association of depression with maternal marijuana use. Interestingly, depression in the

past year was not a significant independent correlate of marijuana use during pregnancy, when controlling for serious psychological distress and the other correlates included in the reduced model. Perhaps the factors influencing the association between depressive symptoms and prenatal marijuana use reported in previous studies were already accounted for through the serious psychological distress variable, and did not allow for depression in the past year to serve independently as a correlate.

Association between Maternal Marijuana Use and Maternal Cigarette Use

Having accounted for the mental health factors of interest, this investigation also considered the most widely accepted correlate of influence – tobacco use. Cigarette use in the past month was found to be associated with a significant increase in the odds of prenatal marijuana use (OR=12.443, 95% CI: 3.822 – 40.512) in support of prior research investigating comorbid substance use during pregnancy[8, 13, 16, 20]. The results from this analysis, however, produced a stronger association between prenatal marijuana and cigarette use than previously reported. The bivariate analysis revealed, in 2014, 66% of pregnant women who used marijuana in the past month in the United States were also using cigarettes in the past month compared to only 9.7% of pregnant marijuana non-users. This is much greater than the co-occurring maternal marijuana and tobacco use prevalence estimates of 54.4% and 58.1% reported by el Marroun et al. (2008) and Conner et al. (2015), respectively[13, 20]. The self-administered and confidential nature of the NSDUH data collection method may have minimized underreporting of substance use and produced much higher prevalence estimates and odds ratios compared to previous studies which might not have allowed for that level of privacy. Given that cigarette use in

the past month was the most significant correlate of prenatal marijuana use in the reduced model, this association emphasizes a potential risk factor and point of intervention for future studies and prevention efforts.

Association between Maternal Marijuana Use and Trimester of Pregnancy

Testing the hypothesis also required investigating the association with of trimester, in order to address nuances within the study population of pregnant women. As noted in the literature, trimester of pregnancy was significantly correlated with prenatal marijuana use. Those in the second trimester (OR=0.313, 5% CI: 0.108 - 0.903) and more so, those in the third trimester (OR=0.059, 95% CI: 0.013 - 0.275) had decreased odds of marijuana use in the past month compared to those in the first trimester of pregnancy. This result echoed all the previous research reporting a decline in maternal marijuana use from first trimester to third trimester[3, 4, 17, 29]. Moreover, given that the study population was restricted to pregnant women, the stratified presentation of the data clearly showed how marijuana non-users were equally distributed among the three trimesters while marijuana users were predominantly in their first trimester of pregnancy. This can be interpreted positively, since these results suggest that marijuana users are more likely to cease use during the course of pregnancy or upon realization of pregnancy. Yet, as the literature also points to how the first trimester of pregnancy may be the most critical time period for fetal neurodevelopment, prenatal exposure to marijuana during the beginning of pregnancy still remains a public health concern.

Association between Maternal Marijuana Use and Age

The moment when pregnancy is confirmed will always be too late to intervene for cases

of prenatal marijuana use; this necessitates greater awareness and education for all

women of reproductive age of the potential harmful effects of engaging in prenatal

marijuana use. Maternal age, specifically the 26-34 year age range, was significantly

associated with decreased odds of prenatal marijuana use when compared to the 18-25

year age range (OR=0.109, 95% CI: 0.026 – 0.446). Younger age was documented as a

correlate of prenatal marijuana use in a number of previous studies, and this analysis

confirms this association for pregnant marijuana users in 2014 in the United States[3, 8, 29].

Furthermore, the sharp differences in age distributions among pregnant marijuana users

and non-users made it essential to retain and adjust for maternal age in the reduced model

in order to generate valid effect estimates.

Association between Maternal Marijuana Use and Perceived Risk of Using Marijuana

The variations in attitudes toward marijuana use also guided the analysis procedure by

adjusting and more precisely estimating the effect between this correlate and the

outcome. Pregnant women who perceived moderate or great risk of smoking marijuana

once or twice a week had significantly decreased odds of prenatal marijuana use

(OR=0.102, 95% CI: 0.026 – 0.393). This result was anticipated by the distributions

noted from the bivariate analysis that illustrated that pregnant marijuana non-users

increasingly perceived greater levels of risk while pregnant marijuana users increasingly

perceived lower levels of risk. Only one previous NSDUH report looked at associations

between prenatal marijuana use and attitudes toward marijuana use and revealed similar

trends in perceived risk among users and non-users[3]. This thesis went further to

incorporate this attitudinal variable in the reduced model and adjust for its effect when assessing the primary relationship between maternal marijuana use and serious psychological distress.

STUDY STRENGTHS AND LIMITATIONS

The primary strength of this thesis was the large sample size and nationally representative nature of the NSDUH. This allowed the study to minimize sampling error and achieve great statistical power. Additionally, all survey frequencies and the logistic regression model were analyzed incorporating cluster- and stratum-specific analysis weights in order that the survey sample be representative of the national population. The NSDUH employs post-stratification procedures for sample data to meet population controls and, therefore, generates better precision and representativeness.

The 2014 NSDUH also provides the most recent national reports for the scope of both substance use and mental health in the United States population. Reviewing previous studies showed that the body of literature concerning maternal marijuana use is growing, however, few studies have presented nationally representative estimates for this outcome. This thesis specifically explored the association between mental health, in the form of serious psychological distress, and maternal marijuana use. The psychological distress variable captured a range of general mental distress symptoms and offered a unique measure of mental health, not limited to the effects of depression, or any distinct mental disorder. No prior study has undertaken this investigation using NSDUH data and, therefore, this study presents novel findings relevant to comorbid mental illness and

maternal marijuana use in the United States for 2014.

Several limitations in this study also warrant discussion. It is first necessary to acknowledge the cross-sectional design of this analysis that prevents establishing causality between maternal marijuana use and the correlates of interest. Instead, strong effect estimates simply indicate significant correlations that demand further prospectively designed studies to determine directionality.

Moreover, the data collection process may reflect several forms of bias. The NSDUH is administered only to the civilian, noninstitutionalized population aged 12 years and older. This excludes active-duty military personnel, persons who are homeless, or residents of institutional group quarters such as jails or hospitals. Individuals excluded from the study based on these criteria may be collectively different in their presentation of mental health and substance use, thereby emphasizing how selection bias might compromise the representativeness of the NSDUH population estimates. Regardless of the confidentiality measures put in place to protect participant privacy during the self-administered survey, self-reporting on drug use and mental illness remains a sensitive task that may be subject to social desirability bias. This creates measurement error in the form of underreporting and a consequent misclassification of the variables of interest, producing effect estimates that may not be valid. Lastly, nonresponse bias could also impact the results of this study as the 2014 NSDUH only had a 58.3% response rate[30]. The differences between survey responders and non-responders (e.g., those who did not complete the survey might have higher levels of drug use than those who did respond) might also bias the reported effect

estimates for this study.

Missing data from those who did complete the survey served as another limitation in this study. The 12-17 year age group of respondents had 0.6-1.4 percent missing data for items specifically related to mental health service utilization[30]. A lack of affirmative responses to these questions would, in turn, then create a chain of missing data points for specific mental health questions regarding depressive symptoms and other mental disorders[30]. Studying this age group as a subset of the pregnant population introduced sparse data for the outcome and correlates of interest, and necessitated eliminating 12-17 year olds from this analysis. Prior studies have shown that marijuana use during pregnancy is significantly associated with younger maternal age, usually adolescence, and excluding this age group greatly limits the scope of results and implications for this study[3, 11, 13, 29].

The dichotomous nature of the outcome variable, marijuana use during pregnancy, restricts the incorporation of marijuana-related variables in the model. The outcome, coded as marijuana use or no use, prevented the inclusion of correlates such as marijuana dependence and marijuana frequency of use in the final model, since they were irrelevant for those reporting no use of marijuana. Given that research establishes notable associations between marijuana dependence and maternal marijuana use, and between frequency of marijuana use and mental health issues, this study is limited in fully accounting for the factors influencing the outcome[3, 14, 29].

IMPLICATIONS FOR PRENATAL SUBSTANCE USE AND PUBLIC HEALTH

The results of this thesis acknowledge the strong association between serious

psychological distress and maternal marijuana use, as well as maternal tobacco use and

maternal marijuana use. This intensifies an already complex public health issue and

presents additional layers of concern. As a favorable first step, these results help identify

high-risk groups who are most in need of education and resources. As this thesis argues

for a greater awareness of comorbid mental illness and tobacco use with maternal

marijuana use, interventions for reducing marijuana use during pregnancy should

integrate efforts to also assess and offer treatment for mental illness and other substance

use.

Based on the results, greater attention must be directed to all women of reproductive age,

but specifically those between 18-25 years of age. The findings also highlight the

generally low perception of risk toward smoking marijuana and demands that this culture

of false beliefs about marijuana be confronted with better education and scientific

evidence.

In the context of public health as a whole, prenatal marijuana use presents a range of

implications and points for intervention. These implications are evidently multifactorial

in scope, and public health must operate to eliminate stigma and improve access to

education, treatment, and prenatal care for pregnant women who use marijuana.

DIRECTIONS FOR FUTURE RESEARCH

The regression model utilized in this study was the first to incorporate attitudes toward marijuana use as a correlate of maternal marijuana use. Given the significant association demonstrating the protective effect of greater perceived risk of using marijuana, future studies should attempt to discern the directionality and extent of influence of these attitudes. Since the current thesis utilized a cross-sectional design, it is difficult to determine if women who initially perceived low risk of using marijuana were more likely to use marijuana once pregnant, or if women who used marijuana while pregnant reported perceiving low risk of marijuana use in order to justify their behavior.

In general, a prospective, longitudinal study design would provide insight to the direction in which maternal marijuana use is related to the correlates of interest, particularly regarding the onset of mental health disorders. Supplemental research is required to discriminate whether use of substances can contribute to mental illness or whether mental illness makes an individual more susceptible to using and becoming dependent on substances. This type of design would also allow for a targeted response to factors that are predictive rather than simply correlated with maternal marijuana use.

This thesis employs a novel approach of studying maternal marijuana use by restricting the study population to only pregnant women. Evaluating the effect of correlates within this refined population allowed the model to propose which correlates were most strongly associated with marijuana use specifically during pregnancy. In this manner, future research should investigate the outcome of mental illness in a population restricted

further to pregnant women who all use marijuana. This would specifically identify the correlates associated with mental illness in pregnant marijuana users and identify more explicit points for intervention in the public health agenda.

CONCLUSION

In summary, prenatal marijuana use is an increasingly prevalent behavior documented alongside the legalization of marijuana across states in the U.S. and the subsequent increase in access to and consumption of marijuana in the general U.S. population. The inconclusive results of reviewing the birth, fetal, and long-term outcomes for the prenatally exposed child warrant continued research in order to confidently characterize the harmful consequences, or lack thereof, of marijuana use during pregnancy.

This analysis supported prior findings, which indicated that maternal tobacco use was the most significant correlate of maternal marijuana use. Hence, there must be an emphasis on promoting educational campaigns to warn of the adverse fetal health outcomes documented for prenatal tobacco use, but also for the comorbid use of tobacco and marijuana. The lack of consensus across states in the U.S. on the right to recreationally use marijuana sends mixed signals to women about the implications of marijuana use during pregnancy and creates a confusing atmosphere in which to navigate what is and is not advised during pregnancy. Moreover, the general disregard for substance use disorders as a medical illness often leads to a greater emphasis on legal ramifications rather than prioritization of the health of the mother and the developing fetus. These circumstances speak to the lack of consideration given to pregnant women with substance

use disorders and paint a troublesome picture of the conditions awaiting pregnant marijuana users who also suffer with mental illness. After maternal tobacco use, serious psychological distress was the second most significant correlate of maternal marijuana use and merits further investigation to uncover the mechanism by which it affects the outcome.

Previous reports describing trends in use during the course of pregnancy show a steady decline of marijuana use from the first trimester through the third trimester, offering a positive point for reflection. This conveys the willingness and ability for women to cease marijuana use during pregnancy and suggests that early intervention and encouragement may prove especially effective in changing this behavior. Therefore, an ideal standard for guidelines for marijuana use should advise against use during pregnancy until a more conclusive result can be obtained through further research. This will hopefully foster a trend toward decreased prevalence of marijuana use during the first trimester of pregnancy, noted as the most sensitive time for fetal neurodevelopment[21].

A combination of mental health conditions, comorbid substance use, sociodemographic information, and attitudes toward marijuana use, together formed the model to explain the outcome of maternal marijuana use. Acknowledging the limitations, this thesis presents nationally representative estimates for the correlates of marijuana use during pregnancy for women aged 18-44 years in 2014 and provides a foundation on which to stimulate more critical investigation of prenatal marijuana use.

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32.   Recoded Mental Health Module Variable Documentation Appendix.

APPENDIX II: DETAILED DATA ANALYSIS METHODS AND RESULTS

VARIABLES OF INTEREST

Outcome = MRJMON (Past Month Marijuana Use)
Exposure = SPDMON (Past Month Serious Psychological Distress)
<u>Correlates (**19 total**)</u>
Sociodemographic
1. TRIMEST (Trimester)
2. CATAGE (Age category)
3. NEWRACE2 (Race/ethnicity)
4. INCOME (4 level income category)
5. IRMARIT (Marital status)
6. SNRLGIMP (Religious beliefs)

Substance Use/Attitudes
1. RSKMJOCC (Perceived risk of smoking MJ 1x month)
2. RSKMJREG (Perceived risk of smoking MJ 1x week)
3. DEPNDMRJ (Past year marijuana dependence)
4. IRMJFM (Marijuana Past Month Frequency of Use, Times/month)
5. CIGMON (Past month cigarette use)
6. CIGYR (Past year cigarette use)
7. DNICNSP (Past month nicotine dependence)

Mental Health
1. ANXDLIF (Anxiety in Lifetime)
2. ANXDYR (Anxiety in past year)
3. DEPRSLIF (Depression in lifetime)
4. DEPRSYR (Depression in past year)
5. SPDYR (Past year serious psychological distress)
6. MI_CAT_U (4 level mental illness category)

CROSSTABS

Frequencies for each variable as a factor of outcome level
<u>NEWRACE2</u> (7 category race/ethnicity variable)

➢ No data for marijuana users who identified as Non-Hispanic Native Hawaiian/Other Pac Islander (4) or Non-Hispanic Asian (5)

➢ Recreated race variable into 4 categories → RACE:

1. Non-Hispanic White
2. Non-Hispanic Black/African American
3. Hispanic
4. Other

<u>IRMJFM</u> (Marijuana Past Month Frequency of Use)

➢ No data for marijuana non-users since frequency of marijuana use is 0

➢ Eliminated this variable from model since it has null values when outcome=0

<u>RSKMJREG</u> (Perceived risk of smoking MJ 1x week)

➢ Levels

1. No Risk
2. Slight Risk
3. Moderate Risk
4. Great Risk

➢ 0.6% of marijuana users responded with level 4 (great risk) → data very sparse for this category

➢ Combined RSKMREG level 4 with level 3 response for analysis

<u>CATAGE</u> (Age category)

➢ Levels

1. 12-17 years
2. 18-24 years
3. 25-34 years
4. 35-44 years

➢ 1.4% of marijuana non-users were within ages 12-17 years → data very sparse for this category

➢ Excluded CATAGE level 1 from analysis

Crosstab Summary:

✓ Excluded variable IRMJFM from model → **18 total** correlates of interest

✓ Replaced 7-level NEWRACE2 variable with 4-level RACE variable

✓ Excluded all participants with CATAGE Level 1 or RSKMJREG Level 4 response

STEPWISE REGRESSION

- ➢ Ran regression for model with only exposure
  - ✓ OR of SPDMON = 12.22, 95% CI (3.85, 38.79)
- ➢ Ran regression for models with exposure and single correlate added
- ➢ Ran regression for models with exposure and incremental number of correlates added, grouped by category (sociodemographic, substance use, or mental health)
- ➢ Assessed condition index for all models with exposure and all correlates within a category
  - ✘ DEPNDMRJ: OR=42.284, upper limit of 95% confidence interval>999 → exclude
  - ✘ RSKMJREG (level 4): lower limit of 95% confidence interval <0.001 → Combine RSKMREG level 4 with level 3 response for analysis

Stepwise Regression Summary:
- ✓ Exclude variable DEPNDMRJ from model → **17 total** correlates of interest
- ✓ Combine RSKMREG level 4 with level 3 response for analysis → matches crosstab results

COLLINEARITY DIAGNOSTICS

Desired condition index < 30
- ➤ Assessed condition index for model with only exposure
  - ✓ Condition index < 30
- ➤ Assessed condition index for all models with exposure and single correlate added
  - ✓ Condition index < 30
- ➤ Assessed condition index for all models with exposure and incremental number of correlates added, grouped by category (sociodemographic, substance use, or mental health)
  - ✓ Condition index < 30
- ➤ Assessed condition index for all models with exposure and all correlates within a category
  - ✓ Condition index < 30
- ➤ Assessed condition index for model with exposure and all 17 correlates
  - ✘ Condition index > 30
- ➤ Assessed condition index for model with exposure, all 17 correlates, and all interaction terms of interest. Interaction of SPDMON (past month serious psych distress) with:
  1. Age
  2. Marital status
  3. Anxiety in past year
  4. Depression in past year
  5. Mental illness category
  6. Income
  7. Perceived risk of smoking marijuana 1x month
  8. Perceived risk of smoking marijuana 1x week
     - ✘ Condition index > 30
- ➤ Starting with full model (**26 variables**: 1 exposure + 17 correlates + 8 interactions terms), conducted a backwards elimination method of eliminating the variable with the highest VDP (>0.5) value. Eliminated:

  1. SPDMON_IRMARIT
  2. SPDMON_INCOME
  3. SPDMON_RSKMJREG
  4. SPDYR
  5. SPDMON_CATAGE
  6. INCOME
  7. SPDMON_ANXDYR
  8. MI_CAT_U & SPDMON*MI_CAT_U

9. IRMARIT
10. SPDMON_RSKMJOCC
11. ANXDLIF
12. RSKMJOCC

Collinearity Summary:

➢ Condition index was only >30 when all 17 correlates were included in model or when all correlates and interaction terms were included

➢ Backwards elimination method removed variables with the highest VDP's until a reduced model with condition index < 30 was achieved

➢ Reduced model (**13 variables**: 1 exposure + 11 correlates + 1 interaction term)

1. SPDMON (exposure)
2. TRIMEST
3. CATAGE
4. RACE
5. SNRLGIMP
6. RSKMJREG
7. CIGYR
8. CIGMON
9. DNICNSP
10. ANXDYR
11. DEPRSLIF
12. DEPRSYR
13. SPDMON_DEPRSYR

SIGNIFICANCE TESTING

➢ Establish correlates of primary interest (not willing to drop from final model):
  1. TRIMEST
  2. CATAGE
  3. RSKMJREG
  4. CIGMON
  5. DEPRSYR
➢ Stepwise backwards elimination method based on test of significance (p>0.05). Eliminated:
  1. SPDMON_DEPRSYR
  2. DEPRSLIF
  3. RACE
  4. CIGYR
  5. DNICNSP
  6. SNRLGIMP
  7. ANXDYR
  8. ANXDLIF
➢ Both DEPRSYR and RSKMJREG had p>0.05 but retained in model because assigned as primary variables of interest

Significance Testing Summary:
➢ Eliminated 8 terms from model including the last interaction term
➢ Reduced model → **6 variables**
  1. SPDMON (exposure)
  2. TRIMEST
  3. CATAGE
  4. RSKMJREG
  5. CIGMON
  6. DEPRSYR

CONFOUNDING ASSESSMENT

Evaluate if dropping a variable results in >10% change in OR of SPDMON
  ➢ Gold standard model: 6 variables
  ➢ Drop one correlate at a time
      ✓ Dropping any variable results in greater than 10% change in estimate
      ✓ Retain all variables in final model → **6 variables**

*Final Regression Model
  ✓ *Outcome* = Past Month Marijuana Use
  ✓ *Exposure* = Past Month Serious Psychological Distress
  ✓ *Correlates*= Trimester, Age, Perceived Risk of Smoking Marijuana 1x a Week, Past Month Cigarette Use, Past Year Depression

APPENDIX III: TABLES

Table 1. Definitions for Pregnancy-Related Terminology

Term	Definition
Prenatal	relating to pregnant women and their unborn babies
Antenatal	prenatal; relating to pregnant women and their unborn babies
Perinatal	happening during or around the time of birth
Postpartum	relating to or happening in the period of time following the birth of a child
Maternal Marijuana Use	use of marijuana specifically during pregnancy

Medical definitions were utilized where applicable[19, 20]

Table 2. Codes for Main Variables of Interest

Variable	Measure	Code	Value
PREG	Pregnant Females Aged 12 - 44	0	Otherwise
		1	Pregnant Females Aged 12-44
MRJMON	Marijuana Use - Past Month	0*	Did not use in the past month
		1	Used within the past month
SPDMON	Past Month Serious Psych Distress Indicator	0*	No
		1	Yes

*Reference group

Table 3. Codes for Pregnancy Related Variables

Variable	Measure	Code	Value
TRIMEST	Current Trimester of Pregnancy – Females Aged 12 - 44	1*	1st 3 Months of Pregnancy
		2	2nd 3 Months of Pregnancy
		3	Last 3 Months of Pregnancy

*Reference group

Table 4. Codes for Substance Use Variables

Variable	Measure	Code	Value
DEPNDMRJ	Marijuana Dependence in the Past Year	0*	No/Unknown
		1	Yes
IRMJFM_C	Marijuana - Past Month Frequency of Use	1	1 - 10 times a month
		2	11-20 times a month
		3	21-30 times a month
CIGYR	Cigarettes - Past Year Use	0*	Did not use in the past year
		1	Used within the past year
CIGMON	Cigarettes - Past Month Use	0*	Did not use in the past month
		1	Used within the past month
DNICNSP	Nicotine Dependence in the Past Month	0*	No
		1	Yes

*Reference group

Table 5. Codes for Attitudinal Variables

Variable	Measure	Code	Value
RSKMJOCC	Risk Smoking Marijuana Once a Month	1[*]	No risk
		2	Slight risk
		3	Moderate risk
		4	Great risk
RSKMJREG	Risk Smoking Marijuana Once or Twice a Week	1[*]	No risk
		2	Slight risk
		3	Moderate risk
		4	Great risk
SNRLGIMP	My Religious Beliefs are Very Important	1[*]	Strongly disagree
		2	Disagree
		3	Agree
		4	Strongly agree

[*]Reference group

Table 6. Codes for Mental Health Variables

Variable	Measure	Code	Value
ANXDYR	Had Anxiety in Past Year	0*	No
		1	Yes
ANXDLIF	Had Anxiety in Lifetime	0*	No
		1	Yes
DEPRSYR	Had Depression in Past Year	0*	No
		1	Yes
DEPRSLIF	Had Depression in Lifetime	0*	No
		1	Yes
SPDYR	Past Year Serious Psych Distress Indicator	0*	No
		1	Yes
MI_CAT_U	Categorical Mental Illness (MI) Indicator	0*	No Past Year MI
		1	Past Year Mild MI
		2	Past Year Moderate MI
		3	Past Year Serious MI

*Reference group

Table 7. Codes for Sociodemographic Variables

Variable	Measure	Code	Value
CATAGE	Age Category	1	12-17 Years Old
		2[*]	18-25 Years Old
		3	26-34 Years Old
		4	35 - 44 Years Old
IRMARIT	Marital Status	1	Married
		3	Divorced or Separated
		4	Never Been Married
NEWRACE2	Race/Hispanicity	1	NonHisp White
		2	NonHisp Black/Afr Am
		3	NonHisp Native Am/AK Native
		4	NonHisp Native HI/Other Pac Isl
		5	NonHisp Asian
		6	NonHisp more than one race
		7	Hispanic
RACE	Race/Hispanicity Recode	1	NonHisp White
		2	NonHisp Black/Afr Am
		3	Hispanic
		4	Other (NEWRACE2=3-6)
INCOME	Total Family Income	1	Less than $20,000
		2	$20,000 - $49,999
		3	$50,000 - $74,999
		4	$75,000 or More

[*]Reference group

Table 8. Prevalence of Prenatal Marijuana Use among Women Aged 12-44 Years, NSDUH 2014

	Weighted N[a]	%	(95% CI)
Marijuana Users[b]	103,582	4.5	(2.8 - 6.2)
Marijuana Non-Users	2,223,191	95.5	(93.9 - 97.2)
Total	2,326,773	100.0	

a Prevalence and percentage estimates have incorporated NSDUH sample design weights. Details of weighting procedures can be found in the 2014 NSDUH Methodological Resource Book

b Marijuana use was defined as use of marijuana at least once in the last 30 days

Table 9. Sociodemographic Characteristics of Pregnant Females Aged 12 - 44 Years Stratified by Past Month Marijuana Use, NSDUH 2014

	Marijuana Users			Marijuana Non-Users		
	Weighted N[a]	%	(95% CI)	Weighted N[a]	%	(95% CI)
Total	103,582	100.0		2,223,191	100.0	
Age, y						
12-17	8,866	8.6	(6.0 - 11.2)	30,547	1.4	(0.6 - 2.2)
18-25	68,120	65.8	(51.7 - 79.9)	724,134	32.6	(28.6 - 36.6)
26-34	14,935	14.4	(0.3 - 28.5)	1,127,035	50.7	(45.2 - 56.2)
35-44	11,661	11.3	(9.5 - 13.1)	341,475	15.4	(10.4 - 20.4)
Race/Hispanicity						
Non-Hispanic White	62,805	60.6	(46.5 - 74.7)	1,241,329	55.8	(51.3 - 60.3)
Non-Hispanic Black/African American	18,240	17.6	(9.2 - 26.0)	310,871	14.0	(10.5 - 17.5)
Non-Hispanic Native American/Alaska Native	2,161	2.1	(1.2 - 3.0)	10,654	0.5	(0.2 - 0.8)
Non-Hispanic Native Hawaiian/Other Pac Islander	-		-	18,371	0.8	(0.3 - 1.3)
Non-Hispanic Asian	-		-	196,591	8.8	(5.0 - 12.6)
Non-Hispanic More than one race	1,666	1.6	(1.3 - 1.9)	45,307	2.0	(0.6 - 3.4)
Hispanic	18,710	18.1	(9.6 - 26.6)	400,068	18.0	(14.7 - 21.3)
Total Family Income						
< $20,000	28,671	27.7	(23.0 - 32.4)	498,058	22.4	(18.2 - 26.6)
$20,000 - $49,999	49,269	47.6	(37.0 - 58.2)	533,899	24.0	(19.4 - 28.4)
$50,000 - $74,999	7,066	6.8	(0.7 - 12.9)	432,505	19.5	(15.7 - 23.3)
> $75,000	18,575	18.0	(13.5 - 22.3)	758,730	34.1	(28.0 - 40.2)
Marital Status[b]						
Married	7,473	7.2	(0.8 - 13.6)	1,364,260	61.5	(56.0 - 67.0)
Divorced or Separated	2,120	2.0	(1.7 - 2.3)	121,676	5.5	(3.8 - 7.2)
Never Been Married	93,988	90.7	(84.2 - 97.2)	730,927	33.0	(27.9 - 38.1)

a Prevalence and percentage estimates have incorporated NSDUH sample design weights. Details of weighting procedures can be found in the 2014 NSDUH Methodological Resource Book **b** These variables excluded data from participants who responded with "don't know", "refuse", or "legitimate skip". Legitimate skip applies to participants for whom the question of interest was not applicable

Table 10. Trimester Distribution of Pregnant Females Aged 12 - 44 Years Stratified by Past Month Marijuana Use, NSDUH 2014

	Marijuana Users			Marijuana Non-Users		
	Weighted N[a]	%	(95% CI)	Weighted N[a]	%	(95% CI)
Total	103,582	100.0		2,223,191	100.0	
Trimester[b]						
1st	63,247	61.1	(54.5 - 67.7)	637,475	29.4	(25.0 - 33.8)
2nd	31,285	30.2	(24.8 - 35.6)	801,418	37.0	(32.1 - 41.9)
3rd	9,050	8.7	(5.2 - 12.2)	728,606	33.6	(28.6 - 38.6)

a Prevalence and percentage estimates have incorporated NSDUH sample design weights. Details of weighting procedures can be found in the 2014 NSDUH Methodological Resource Book
b These variables excluded data which were missing

Table 11. Substance Use Characteristics of Pregnant Females Aged 12 - 44 Years Stratified by Past Month Marijuana Use, NSDUH 2014

	Marijuana Users			Marijuana Non-Users		
	Weighted Nᵃ	%	(95% CI)	Weighted Nᵃ	%	(95% CI)
Total	103,582	100.0		2,223,191	100.0	
Marijuana Past Year Dependence						
Yes	6,789	6.6	(5.2 - 8.0)	1440	0.1	(0.0 - 0.2)
No/Unknown	96,793	93.4	(92.0 - 94.8)	2,221,751	99.9	(99.8 - 100.0)
Marijuana Past Month Frequency of Use, Times/month						
1-10	69,484	67.1	(61.5 - 72.7)	-		-
11-20	18,726	18.1	(9.6 - 26.6)	-		-
21-30	15,373	14.8	(7.6 - 22.0)	-		-
Cigarette Past Month Use						
Yes	68,628	66.3	(57.5 - 75.1)	216,689	9.7	(6.7 - 12.7)
No	34,953	33.7	(24.9 - 42.5)	2,006,502	90.3	(87.3 - 93.3)
Cigarette Past Year Use						
Yes	83,609	80.7	(73.3 - 88.1)	455,649	20.5	(17.1 - 23.9)
No	19,973	19.3	(11.9 - 26.7)	1,767,542	79.5	(76.1 - 82.9)
Nicotine Past Month Dependence						
Yes	46,410	44.8	(32.6 - 57.0)	96,876	4.4	(2.7 - 6.1)
No	57,172	55.2	(43.0 - 67.4)	2,126,315	95.6	(93.9 - 97.3)

a Prevalence and percentage estimates have incorporated NSDUH sample design weights. Details of weighting procedures can be found in the 2014 NSDUH Methodological Resource Book
b These variables excluded data which were missing

Table 12. Mental Health Characteristics of Pregnant Females Aged 12 - 44 Years Stratified by Past Month Marijuana Use, NSDUH 2014

	Marijuana Users			Marijuana Non-Users		
	Weighted N[a]	**%**	**(95% CI)**	**Weighted N[a]**	**%**	**(95% CI)**
Total	103,582	100.0		2,223,191	100.0	
Serious Psychological Distress in Past Month[b, c]						
Yes	31,276	33.0	(20.35 - 45.65)	85,028	3.9	(2.35 - 5.45)
No	63,439	67.0	(54.35 - 79.65)	2,107,616	96.1	(94.55 - 97.65)
Serious Psychological Distress in Past Year[c]						
Yes	47,954	50.6	(36.15 - 65.05)	245,214	11.2	(8.45 - 13.95)
No	46,762	49.4	(34.95 - 63.85)	1,947,431	88.8	(86.05 - 91.55)
Past Year Mental Illness Indicator[b]						
No MI	49,485	52.2	(42.27 - 62.13)	1,816,079	82.8	(79.59 - 86.01)
Mild MI	8,192	8.6	(0.78 - 16.42)	207,411	9.5	(6.87 - 12.13)
Moderate MI	2,513	2.7	(2.24 - 3.16)	119,629	5.5	(3.10 - 7.90)
Serious MI	34,526	36.5	(23.14 - 49.86)	49,526	2.3	(0.91 - 3.69)
Had Depression in Past Year[b]						
Yes	37,382	36.1	(21.46 - 50.74)	139,062	6.5	(4.39 - 8.61)
No	66,200	63.9	(49.26 - 78.54)	1,969,608	92.2	(90.9 - 94.31)
Had Depression in Lifetime[b]						
Yes	45,291	43.7	(29.15 - 58.25)	319,098	14.8	(12.22 - 17.38)
No	58,291	56.3	(41.75 - 70.85)	1,829,793	85.2	(82.62 - 87.78)
Had Anxiety in Past Year[b]						
Yes	27,832	26.9	(13.45 - 40.35)	122,769	5.7	(3.25 - 8.15)
No	75,750	73.1	(59.65 - 86.55)	2,026,122	94.3	(91.85 - 96.75)
Had Anxiety in Lifetime[b]						
Yes	29,463	28.4	(16.59 - 40.21)	236,102	11.0	(7.97 - 14.03)
No	74,119	71.6	(59.79 - 83.41)	1,912,789	89.0	(85.97 - 92.03)

a Prevalence and percentage estimates have incorporated NSDUH sample design weights. Details of weighting procedures can be found in the 2014 NSDUH Methodological Resource Book

b These variables excluded data which were missing

c Serious psychological distress was classified based on the Kessler 6 (K6) scale which is intended for persons aged 18 years or older. This variable therefore excludes data from participants aged 12-17 years

Table 13. Attitudes of Pregnant Females Aged 12 - 44 Years Stratified by Past Month Marijuana Use, NSDUH 2014 [a]

	Marijuana Users			Marijuana Non-Users		
	Weighted N[a]	%	(95% CI)	Weighted N[a]	%	(95% CI)
Total	103,582	100.0		2,223,191	100.0	
Perceived Risk of Smoking Marijuana 1x Month[b]						
No Risk	57,928	55.9	(45.7 - 66.1)	450,082	20.5	(17.3 - 23.7)
Slight Risk	38,790	37.4	(27.4 - 47.4)	680,125	31.1	(26.5 - 35.7)
Moderate Risk	4,289	4.1	(2.7 - 5.5)	447,538	20.4	(17.2 - 23.6)
Great Risk	2,574	2.5	(2.1 - 2.9)	612,519	28.0	(23.3 - 32.7)
Perceived Risk of Smoking Marijuana 1 or 2x Week[b]						
No Risk	58,367	56.3	(46.2 - 66.4)	323898	14.8	(11.6 - 18.0)
Slight Risk	38,281	37.0	(26.0 - 48.0)	533,190	24.3	(20.7 - 27.9)
Moderate Risk	6,356	6.1	(1.3 - 10.9)	609,938	27.8	(23.0 - 32.6)
Great Risk	578	0.6	(0.5 - 0.7)	724,542	33.1	(27.8 - 38.4)
Religious Beliefs Important[b]						
Strongly Disagree	25,265	27.2	(7.5 - 46.9)	221,393	10.4	(7.4 - 13.4)
Disagree	14,089	15.2	(10.0 - 20.4)	280,351	13.2	(9.4 - 17.0)
Agree	29,391	31.7	(17.7 - 45.7)	760,986	35.8	(31.1 - 40.5)
Strongly Agree	24,027	25.9	(20.7 - 31.1)	862,202	40.6	(35.5 - 45.7)

a Prevalence and percentage estimates have incorporated NSDUH sample design weights. Details of weighting procedures can be found in the 2014 NSDUH Methodological Resource Book

b These variables excluded data from participants who responded with "don't know", "refuse", or "legitimate skip". Legitimate skip applies to participants for whom the question of interest was not applicable

Table 14. Sociodemographic, Attitudinal, Substance Use and Mental Health Correlates of Past-Month Pregnant Marijuana Users Aged 18-44 Years in the United States, NSDUH 2014

Variable	OR$_{adj}$ (95% CI)[c, d]	p-value
Past Month Serious Psych Distress[b]		
Yes	6.667 (1.148 - 38.707)	0.0345
No	1.000 [Reference]	
Trimester		
1st	1.000 [Reference]	
2nd	0.313 (0.108 - 0.903)	0.0317
3rd	0.059 (0.013 - 0.275)	0.0003
Age[e], years		
18-25	1.000 [Reference]	
26-34	0.109 (0.026 - 0.446)	0.0021
35-44	0.395 (0.108 - 1.440)	0.1591
Perceived Risk of Marijuana Use 1/2x a Week		
No Risk	1.000 [Reference]	
Slight Risk	0.859 (0.259 - 2.842)	0.8029
Moderate or Great Risk	0.102 (0.026 - 0.393)	0.0009
Past Month Cigarette Use		
Yes	12.443 (3.822 - 40.512)	<.0001
No	1.000 [Reference]	
Depression in Past Year[b]		
Yes	2.936 (0.676 - 12.753)	0.1507
No	1.000 [Reference]	

a Adjusted odds ratio estimates have incorporated NSDUH sample design weights. Details of weighting procedures can be found in the 2014 NSDUH Methodological Resource Book

b Serious psychological distress was classified based on the Kessler 6 (K6) scale which is intended for persons aged 18 years or older. This variable therefore excludes data from participants aged 12-17 years

c Values are regression coefficients (OR) and 95% Confidence Intervals (95% CI) relative to the marijuana non-using group and are adjusted for all other correlates in the final model

d Models were constructed using multinomial logistic regression with backward selection. Non-significant (p>0.05) predictors were dropped out of the model unless previously specified as primary variables of interest (depression in past year, perceived risk of smoking marijuana 1/2x a week)

e Participants who were 12-17 years old were excluded from this analysis due to sparse data

APPENDIX IV: SAS CODE

```
/*******************************************************************************
Filename: nsduh2014.sas
Input: 2014 NSDUH SAS datafile publicly accessible @ http://www.samhsa.gov/samhsa-data-outcomes-quality/major-data-collections/public-use-files-2014-nsduh
Created by: Catherine Koola
Creation Date: January 2016
Purpose: Preparation and analysis (survey design accommodated) of NSDUH 2014 data for purposes of masters thesis
Updates: Jan/Feb/March/April 2016
*******************************************************************************/


libname koola 'H:\THESIS\Koola Files';

proc contents data=koola.nsduh2014;
run;


*******************************************************************
*                      D A T A    S T E P                        *
*****************************************************************;

data nsduh2014;
      set koola.nsduh2014;

      *create new dataset with only the variables of interest;
      keep vestr verep analwt_c PREG TRIMEST MRJMON DEPNDMRJ IRMJFM RSKMJOCC RSKMJREG CIGMON CIGYR DNICNSP
ANXDLIF ANXDYR DEPRSLIF DEPRSYR SPDMON SPDYR IRMARIT NEWRACE2 SNRLGIMP INCOME MI_CAT_U CATAGE;

run;

data nsduh2014;
      set nsduh2014;

      *recode "legitimate skip" responses for marital status to missing;
      if IRMARIT=99 then IRMARIT=.;

      *recode "refused" "don't know" and "legitimate skip" responses for religious beliefs to missing;
      if SNRLGIMP=99 then SNRLGIMP=.;
      if SNRLGIMP=97 then SNRLGIMP=.;
```

```
        if SNRLGIMP=94 then SNRLGIMP=.;

        *recode "don't know" responses for perceived risk of marijuana use to missing;
        if RSKMJOCC=94 then RSKMJOCC=.;
        if RSKMJREG=94 then RSKMJREG=.;

        *create marijuana past month frequency of use variable categories;
        if 0<=IRMJFM<11 then IRMJFM_C=1;
        if 11<=IRMJFM<21 then IRMJFM_C=2;
        if 21<=IRMJFM<=30 then IRMJFM_C=3;

        proc format;
        value frequency         1="0-10 times a month"
                                2="11-20 times a month"
                                3="21-30 times a month";
run;
********************************************************************;


*check to see if new variable was created correctly;
proc freq data=nsduh2014;
        table IRMJFM_C;
        format IRMJFM_C frequency.;
run;

proc freq data=nsduh2014;
        table PREG*MRJMON*IRMARIT;
run;


*****************************************************************
*                       T A B L E   1                         *
*****************************************************************;


*Table will be stratified by pregnant marijuana users vs. non users
Each variable within each stratum will sum to 100% of the observations for that particular category;
```

```
*******************************************************************
*                         Total Overall                          *
*******************************************************************;
*total frequency of pregnant marijuana users vs. nonusers;
proc surveyfreq data=nsduh2014;
      stratum vestr;
      cluster verep;
      weight analwt_c;
      table PREG*MRJMON;
      where PREG=1;
run;


*******************************************************************
*                          Trimester                             *
*******************************************************************;
*trimester frequencies of pregnant marijuana users vs. nonusers;
proc surveyfreq data=nsduh2014;
      stratum vestr;
      cluster verep;
      weight analwt_c;
      table PREG*MRJMON*TRIMEST;
      where PREG=1 and MRJMON=1;
run;


proc surveyfreq data=nsduh2014;
      stratum vestr;
      cluster verep;
      weight analwt_c;
      table PREG*MRJMON*TRIMEST;
      where PREG=1 and MRJMON=0;
run;


*******************************************************************
*          Substance Use: Marijuana Dependence            *
*******************************************************************;
*past year marijuana dependence frequencies of pregnant marijuana users vs. nonusers;
proc surveyfreq data=nsduh2014;
      stratum vestr;
      cluster verep;
      weight analwt_c;
      table PREG*MRJMON*DEPNDMRJ;
```

```sas
      where PREG=1 and MRJMON=1;
run;

proc surveyfreq data=nsduh2014;
      stratum vestr;
      cluster verep;
      weight analwt_c;
      table PREG*MRJMON*DEPNDMRJ;
      where PREG=1 and MRJMON=0;
run;

*********************************************************************
*                 Substance Use: Marijuana Dependence             *
*********************************************************************;

*past month marijuana frequency of use in pregnant marijuana users vs. nonusers;

proc surveyfreq data=nsduh2014;
      stratum vestr;
      cluster verep;
      weight analwt_c;
      table PREG*MRJMON*IRMJFM;
      where PREG=1 and MRJMON=1;
run;


proc surveyfreq data=nsduh2014;
      stratum vestr;
      cluster verep;
      weight analwt_c;
      table PREG*MRJMON*IRMJFM_C;
      where PREG=1 and MRJMON=1;
run;

proc surveyfreq data=nsduh2014;
      stratum vestr;
      cluster verep;
      weight analwt_c;
      table PREG*MRJMON*IRMJFM_C;
      where PREG=1 and MRJMON=0;
run;
```

```sas
*by trimester;
proc surveyfreq data=nsduh2014;
      stratum vestr;
      cluster verep;
      weight analwt_c;
      table PREG*MRJMON*IRMJFM_C;
      where PREG=1 and MRJMON=1 and TRIMEST=3;
run;



********************************************************************
*            Attitudes: Perceived Risk of Marijuana              *
********************************************************************;

*perceived risk marijuana use (1x month) frequencies of pregnant marijuana users vs. nonusers;
proc surveyfreq data=nsduh2014;
      stratum vestr;
      cluster verep;
      weight analwt_c;
      table PREG*MRJMON*RSKMJOCC;
      where PREG=1 and MRJMON=0;
run;

proc surveyfreq data=nsduh2014;
      stratum vestr;
      cluster verep;
      weight analwt_c;
      table PREG*MRJMON*RSKMJOCC;
      where PREG=1 and MRJMON=1;
run;

*perceived risk marijuana use (1/2x month) frequencies of pregnant marijuana users vs. nonusers;
proc surveyfreq data=nsduh2014;
      stratum vestr;
      cluster verep;
      weight analwt_c;
      table PREG*MRJMON*RSKMJREG;
      where PREG=1 and MRJMON=1;
run;
```

```
proc surveyfreq data=nsduh2014;
      stratum vestr;
      cluster verep;
      weight analwt_c;
      table PREG*MRJMON*RSKMJREG;
      where PREG=1 and MRJMON=0;
run;

*********************************************************************
*                  Substance Use: Cigarette Use                   *
*********************************************************************;

*cigarette past month frequencies of pregnant marijuana users vs. nonusers;
proc surveyfreq data=nsduh2014;
      stratum vestr;
      cluster verep;
      weight analwt_c;
      table PREG*MRJMON*CIGMON;
      where PREG=1 and MRJMON=1;
run;

proc surveyfreq data=nsduh2014;
      stratum vestr;
      cluster verep;
      weight analwt_c;
      table PREG*MRJMON*CIGMON;
      where PREG=1 and MRJMON=0;
run;

*cigarette past year frequencies of pregnant marijuana users vs. nonusers;
proc surveyfreq data=nsduh2014;
      stratum vestr;
      cluster verep;
      weight analwt_c;
      table PREG*MRJMON*CIGYR;
      where PREG=1 and MRJMON=1;
run;

proc surveyfreq data=nsduh2014;
      stratum vestr;
```

```
        cluster verep;
        weight analwt_c;
        table PREG*MRJMON*CIGYR;
        where PREG=1 and MRJMON=0;
run;

*nicotine dependence past month frequencies of pregnant marijuana users vs. nonusers;
proc surveyfreq data=nsduh2014;
        stratum vestr;
        cluster verep;
        weight analwt_c;
        table PREG*MRJMON*DNICNSP;
        where PREG=1 and MRJMON=1;
run;

proc surveyfreq data=nsduh2014;
        stratum vestr;
        cluster verep;
        weight analwt_c;
        table PREG*MRJMON*DNICNSP;
        where PREG=1 and MRJMON=0;
run;

********************************************************************
*                     Mental Health: Anxiety                      *
********************************************************************;

*anxiety in lifetime frequencies of pregnant marijuana users vs. nonusers;
proc surveyfreq data=nsduh2014;
        stratum vestr;
        cluster verep;
        weight analwt_c;
        table PREG*MRJMON*ANXDLIF;
        where PREG=1 and MRJMON=1;
run;

proc surveyfreq data=nsduh2014;
        stratum vestr;
        cluster verep;
        weight analwt_c;
        table PREG*MRJMON*ANXDLIF;
```

```
       where PREG=1 and MRJMON=0;
run;


*anxiety in past year frequencies of pregnant marijuana users vs. nonusers;
proc surveyfreq data=nsduh2014;
       stratum vestr;
       cluster verep;
       weight analwt_c;
       table PREG*MRJMON*ANXDYR;
       where PREG=1 and MRJMON=1;
run;


proc surveyfreq data=nsduh2014;
       stratum vestr;
       cluster verep;
       weight analwt_c;
       table PREG*MRJMON*ANXDYR;
       where PREG=1 and MRJMON=0;
run;


********************************************************************
*                  Mental Health: Depression                     *
*******************************************************************;


*depression in lifetime frequencies of pregnant marijuana users vs. nonusers;
proc surveyfreq data=nsduh2014;
       stratum vestr;
       cluster verep;
       weight analwt_c;
       table PREG*MRJMON*DEPRSLIF;
       where PREG=1 and MRJMON=1;
run;


proc surveyfreq data=nsduh2014;
       stratum vestr;
       cluster verep;
       weight analwt_c;
       table PREG*MRJMON*DEPRSLIF;
       where PREG=1 and MRJMON=0;
run;
```

```sas
*depression in past year frequencies of pregnant marijuana users vs. nonusers;
proc surveyfreq data=nsduh2014;
      stratum vestr;
      cluster verep;
      weight analwt_c;
      table PREG*MRJMON*DEPRSYR;
      where PREG=1 and MRJMON=1;
run;

proc surveyfreq data=nsduh2014;
      stratum vestr;
      cluster verep;
      weight analwt_c;
      table PREG*MRJMON*DEPRSYR;
      where PREG=1 and MRJMON=0;
run;

*******************************************************************
*                  Mental Health: Serious Psych Distress          *
******************************************************************;


*serious psyc distress in past month frequencies of pregnant marijuana users vs. nonusers;
proc surveyfreq data=nsduh2014;
      stratum vestr;
      cluster verep;
      weight analwt_c;
      table PREG*MRJMON*SPDMON;
      where PREG=1 and MRJMON=1;
run;

proc surveyfreq data=nsduh2014;
      stratum vestr;
      cluster verep;
      weight analwt_c;
      table PREG*MRJMON*SPDMON;
      where PREG=1 and MRJMON=0;
run;
```

```
*serious psyc distress in past year frequencies of pregnant marijuana users vs. nonusers;
proc surveyfreq data=nsduh2014;
      stratum vestr;
      cluster verep;
      weight analwt_c;
      table PREG*MRJMON*SPDYR;
      where PREG=1 and MRJMON=1;
run;

proc surveyfreq data=nsduh2014;
      stratum vestr;
      cluster verep;
      weight analwt_c;
      table PREG*MRJMON*SPDYR;
      where PREG=1 and MRJMON=0;
run;


******************************************************************
*               Mental Health: Illness Indicator               *
******************************************************************;


*mental health category frequencies of pregnant marijuana users vs. nonusers;
proc surveyfreq data=nsduh2014;
      stratum vestr;
      cluster verep;
      weight analwt_c;
      table PREG*MRJMON*MI_CAT_U;
      where PREG=1 and MRJMON=1;
run;

proc surveyfreq data=nsduh2014;
      stratum vestr;
      cluster verep;
      weight analwt_c;
      table PREG*MRJMON*MI_CAT_U;
      where PREG=1 and MRJMON=0;
run;
```

```
*********************************************************************
*                    Demographics: Marital Status                  *
*********************************************************************;


*marital status frequencies of pregnant marijuana users vs. nonusers;
proc surveyfreq data=nsduh2014;
      stratum vestr;
      cluster verep;
      weight analwt_c;
      table PREG*MRJMON*IRMARIT;
      where PREG=1 and MRJMON=1;
run;

proc surveyfreq data=nsduh2014;
      stratum vestr;
      cluster verep;
      weight analwt_c;
      table PREG*MRJMON*IRMARIT;
      where PREG=1 and MRJMON=0;
run;


*********************************************************************
*                    Demographics: Ethnicity                       *
*********************************************************************;

*race frequencies of pregnant marijuana users vs. nonusers;
proc surveyfreq data=nsduh2014;
      stratum vestr;
      cluster verep;
      weight analwt_c;
      table PREG*MRJMON*NEWRACE2;
      where PREG=1 and MRJMON=1;
run;

proc surveyfreq data=nsduh2014;
      stratum vestr;
      cluster verep;
      weight analwt_c;
      table PREG*MRJMON*NEWRACE2;
```

```
        where PREG=1 and MRJMON=0;
run;


********************************************************************
*                 Attitudes: Religious Beliefs                    *
********************************************************************;


*religious beliefs important frequencies of pregnant marijuana users vs. nonusers;
proc surveyfreq data=nsduh2014;
       stratum vestr;
       cluster verep;
       weight analwt_c;
       table PREG*MRJMON*SNRLGIMP;
       where PREG=1 and MRJMON=1;
run;


proc surveyfreq data=nsduh2014;
       stratum vestr;
       cluster verep;
       weight analwt_c;
       table PREG*MRJMON*SNRLGIMP;
       where PREG=1 and MRJMON=0;
run;


********************************************************************
*                  Demographics: Income                           *
********************************************************************;


*total family income important frequencies of pregnant marijuana users vs. nonusers;
proc surveyfreq data=nsduh2014;
       stratum vestr;
       cluster verep;
       weight analwt_c;
       table PREG*MRJMON*INCOME;
       where PREG=1 and MRJMON=1;
run;


proc surveyfreq data=nsduh2014;
       stratum vestr;
       cluster verep;
       weight analwt_c;
```

```
      table PREG*MRJMON*INCOME;
      where PREG=1 and MRJMON=0;
run;


******************************************************************
*                 Demographics: Age                             *
******************************************************************;

*age category frequencies of pregnant marijuana users vs. nonusers;
proc surveyfreq data=nsduh2014;
      stratum vestr;
      cluster verep;
      weight analwt_c;
      table PREG*MRJMON*CATAGE;
      where PREG=1 and MRJMON=1;
run;

proc surveyfreq data=nsduh2014;
      stratum vestr;
      cluster verep;
      weight analwt_c;
      table PREG*MRJMON*CATAGE;
      where PREG=1 and MRJMON=0;
run;
```

```
libname koola 'H:\THESIS\Koola Files';

*********************************************************************
*            D A T A   S T E P for D I A G N O S T I C S          *
********************************************************************;

data nsduh2014;
     set koola.nsduh2014;

     *create new dataset with only the variables of interest;
     keep vestr verep analwt_c PREG TRIMEST MRJMON DEPNDMRJ IRMJFM RSKMJOCC RSKMJREG CIGMON CIGYR DNICNSP
ANXDLIF ANXDYR DEPRSLIF DEPRSYR SPDMON SPDYR IRMARIT NEWRACE2 SNRLGIMP INCOME MI_CAT_U CATAGE;
     if CATAGE>1;
run;

data nsduh2014;
     set koola.nsduh2014;

     *create new dataset with only the variables of interest;
     keep vestr verep analwt_c PREG TRIMEST MRJMON DEPNDMRJ IRMJFM RSKMJOCC RSKMJREG CIGMON CIGYR DNICNSP
ANXDLIF ANXDYR DEPRSLIF DEPRSYR SPDMON SPDYR IRMARIT NEWRACE2 SNRLGIMP INCOME MI_CAT_U CATAGE;
     if CATAGE>1;
run;

data nsduh2014;
     set nsduh2014;

     if PREG=1;

     *recode "legitimate skip" responses for marital status to missing;
     if IRMARIT=99 then IRMARIT=.;

     *recode "refused" "don't know" and "legitimate skip" responses for religious beliefs to missing;
     if SNRLGIMP=99 then SNRLGIMP=.;
     if SNRLGIMP=97 then SNRLGIMP=.;
     if SNRLGIMP=94 then SNRLGIMP=.;

     *recode "don't know" responses for perceived risk of marijuana use to missing;
     if RSKMJOCC=94 then RSKMJOCC=.;
     if RSKMJREG=94 then RSKMJREG=.;
```

```sas
*create marijuana past month frequency of use variable categories;
if 0<=IRMJFM<11 then IRMJFM_C=1;
if 11<=IRMJFM<21 then IRMJFM_C=2;
if 21<=IRMJFM<=30 then IRMJFM_C=3;

*create new 4 category race variable to combine newrace2 3-6;
if NEWRACE2=1 then RACE=1;
if NEWRACE2=2 then RACE=2;
if NEWRACE2=7 then RACE=3;
if NEWRACE2=3 then RACE=4;
if NEWRACE2=4 then RACE=4;
if NEWRACE2=5 then RACE=4;
if NEWRACE2=6 then RACE=4;

*create new interaction terms;
SPDMON_IRMARIT=SPDMON*IRMARIT;
SPDMON_CATAGE=SPDMON*CATAGE;
SPDMON_ANXDYR=SPDMON*ANXDYR;
SPDMON_DEPRSYR=SPDMON*DEPRSYR;
SPDMON_MICATU=SPDMON*MI_CAT_U;
SPDMON_RSKMJOCC=SPDMON*RSKMJOCC;
SPDMON_RSKMJREG=SPDMON*RSKMJREG;
SPDMON_INCOME=SPDMON*INCOME;


proc format;
value frequency        1="0-10 times a month"
                       2="11-20 times a month"
                       3="21-30 times a month";

value yesno            1="1Yes"
                       0="2No";
run;



**********************************************************************
*                   E N D   D A T A   S T E P                      *
**********************************************************************;
```

```
**********************************************************************
*                    C O L L I N E A R I T Y                         *
*            Proc Survey Logistic - Macro Code                       *
**********************************************************************;

%include "H:\THESIS\Koola Files\collin_2011.sas";

*exposure only model;
proc surveylogistic data=nsduh2014;
      stratum vestr;
      cluster verep;
      weight analwt_c;
      model mrjmon(event='1')= SPDMON/covB;
      ods output surveylogistic.covb=covfile;
run;
%Collin(COVDSN=covfile,PROCDR=SURVEYLOGISTIC,OUTPUT=dataset);


***********************
* SOCIODEMOGRAPHIC    *
***********************;

*exposure and trimeseter only model;
proc surveylogistic data=nsduh2014;
      stratum vestr;
      cluster verep;
      weight analwt_c;
      class TRIMEST (ref='1') / param=ref order=internal;
      model mrjmon (event='1') = SPDMON TRIMEST/covB;
      ods output surveylogistic.covb=covfile;
run;
%Collin(COVDSN=covfile,PROCDR=SURVEYLOGISTIC,OUTPUT=dataset);

*exposure and age only model;
proc surveylogistic data=nsduh2014;
      stratum vestr;
      cluster verep;
      weight analwt_c;
      class CATAGE (ref='2') / param=ref order=internal;
      model mrjmon (event='1') = SPDMON CATAGE / covB;
      ods output surveylogistic.covb=covfile;
run;
```

```
%Collin(COVDSN=covfile,PROCDR=SURVEYLOGISTIC,OUTPUT=dataset);

*exposure, trimester, and age only model;
proc surveylogistic data=nsduh2014;
      stratum vestr;
      cluster verep;
      weight analwt_c;
      class CATAGE (ref='2') TRIMEST (ref='1') / param=ref order=internal;
      model mrjmon (event='1') = SPDMON TRIMEST CATAGE / covB;
      ods output surveylogistic.covb=covfile;
run;
%Collin(COVDSN=covfile,PROCDR=SURVEYLOGISTIC,OUTPUT=dataset);

*exposure and race only model;
proc surveylogistic data=nsduh2014;
      stratum vestr;
      cluster verep;
      weight analwt_c;
      class RACE (ref='1') / param=ref order=internal;
      model mrjmon (event='1') = SPDMON RACE / covB;
      ods output surveylogistic.covb=covfile;
run;
%Collin(COVDSN=covfile,PROCDR=SURVEYLOGISTIC,OUTPUT=dataset);

*exposure and income only model;
proc surveylogistic data=nsduh2014;
      stratum vestr;
      cluster verep;
      weight analwt_c;
      class INCOME (ref='1') / param=ref order=internal;
      model mrjmon (event='1') = SPDMON INCOME/ covB;
      ods output surveylogistic.covb=covfile;
run;
%Collin(COVDSN=covfile,PROCDR=SURVEYLOGISTIC,OUTPUT=dataset);

*exposure and marital status only model;
proc surveylogistic data=nsduh2014;
      stratum vestr;
      cluster verep;
      weight analwt_c;
      class IRMARIT (ref='1') / param=ref order=internal;
```

```
        model mrjmon (event='1') = SPDMON IRMARIT/ covB;
        ods output surveylogistic.covb=covfile;
run;
%Collin(COVDSN=covfile,PROCDR=SURVEYLOGISTIC,OUTPUT=dataset);

*exposure, race, and income model;
proc surveylogistic data=nsduh2014;
        stratum vestr;
        cluster verep;
        weight analwt_c;
        class RACE (ref='1') INCOME (ref='1') / param=ref order=internal;
        model mrjmon (event='1') = SPDMON RACE INCOME/ covB;
        ods output surveylogistic.covb=covfile;
run;
%Collin(COVDSN=covfile,PROCDR=SURVEYLOGISTIC,OUTPUT=dataset);

*exposure, race, and marital status model;
proc surveylogistic data=nsduh2014;
        stratum vestr;
        cluster verep;
        weight analwt_c;
        class RACE (ref='1') IRMARIT (ref='1') / param=ref order=internal;
        model mrjmon (event='1') = SPDMON RACE IRMARIT/ covB;
        ods output surveylogistic.covb=covfile;
run;
%Collin(COVDSN=covfile,PROCDR=SURVEYLOGISTIC,OUTPUT=dataset);

*exposure, income, and marital status model;
proc surveylogistic data=nsduh2014;
        stratum vestr;
        cluster verep;
        weight analwt_c;
        class INCOME (ref='1') IRMARIT (ref='1') / param=ref order=internal;
        model mrjmon (event='1') = SPDMON IRMARIT INCOME/ covB;
        ods output surveylogistic.covb=covfile;
run;
%Collin(COVDSN=covfile,PROCDR=SURVEYLOGISTIC,OUTPUT=dataset);

*exposure, race, income, and marital status model;
proc surveylogistic data=nsduh2014;
        stratum vestr;
```

```
        cluster verep;
        weight analwt_c;
        class RACE (ref='1') INCOME (ref='1') IRMARIT (ref='1') / param=ref order=internal;
        model mrjmon (event='1') = SPDMON RACE IRMARIT INCOME/ covB;
        ods output surveylogistic.covb=covfile;
run;
%Collin(COVDSN=covfile,PROCDR=SURVEYLOGISTIC,OUTPUT=dataset);


*exposure, trimester, race, income, and marital status model;
proc surveylogistic data=nsduh2014;
        stratum vestr;
        cluster verep;
        weight analwt_c;
        class TRIMEST (ref='1') RACE (ref='1') INCOME (ref='1') IRMARIT (ref='1') / param=ref order=internal;
        model mrjmon (event='1') = SPDMON TRIMEST RACE IRMARIT INCOME/ covB;
        ods output surveylogistic.covb=covfile;
run;
%Collin(COVDSN=covfile,PROCDR=SURVEYLOGISTIC,OUTPUT=dataset);


*exposure, age, race, income, and marital status model;
proc surveylogistic data=nsduh2014;
        stratum vestr;
        cluster verep;
        weight analwt_c;
        class CATAGE (ref='2') RACE (ref='1') INCOME (ref='1') IRMARIT (ref='1') / param=ref order=internal;
        model mrjmon (event='1') = SPDMON CATAGE RACE IRMARIT INCOME/ covB;
        ods output surveylogistic.covb=covfile;
run;
%Collin(COVDSN=covfile,PROCDR=SURVEYLOGISTIC,OUTPUT=dataset);


*exposure, trimester, age, race, income, and marital status model;
proc surveylogistic data=nsduh2014;
        stratum vestr;
        cluster verep;
        weight analwt_c;
        class TRIMEST (ref='1') CATAGE (ref='2') RACE (ref='1') INCOME (ref='1') IRMARIT (ref='1') /
param=ref order=internal;
        model mrjmon (event='1') = SPDMON TRIMEST CATAGE RACE IRMARIT INCOME/ covB;
        ods output surveylogistic.covb=covfile;
run;
%Collin(COVDSN=covfile,PROCDR=SURVEYLOGISTIC,OUTPUT=dataset);
```

```
*exposure and religious beliefs only model;
proc surveylogistic data=nsduh2014;
      stratum vestr;
      cluster verep;
      weight analwt_c;
      class SNRLGIMP(ref='1') / param=ref order=internal;
      model mrjmon (event='1') = SPDMON SNRLGIMP/ covB;
      ods output surveylogistic.covb=covfile;
run;
%Collin(COVDSN=covfile,PROCDR=SURVEYLOGISTIC,OUTPUT=dataset);

*exposure, trimester, age, race, income, and marital status, and religious beliefs;
proc surveylogistic data=nsduh2014;
      stratum vestr;
      cluster verep;
      weight analwt_c;
      class TRIMEST (ref='1') CATAGE (ref='2') RACE (ref='1') INCOME (ref='1') IRMARIT (ref='1')
SNRLGIMP(ref='1') / param=ref order=internal;
      model mrjmon (event='1') = SPDMON TRIMEST CATAGE RACE IRMARIT INCOME SNRLGIMP/ covB;
      ods output surveylogistic.covb=covfile;
run;
%Collin(COVDSN=covfile,PROCDR=SURVEYLOGISTIC,OUTPUT=dataset);

** all condition indices under 30 **

*****************************
* SUBSTANCE USE & ATTITUDES  *
****************************;

*exposure and past year marijuana dependence;
proc surveylogistic data=nsduh2014;
      stratum vestr;
      cluster verep;
      weight analwt_c;
      model mrjmon (event='1') = SPDMON DEPNDMRJ/ covB;
      ods output surveylogistic.covb=covfile;
run;
%Collin(COVDSN=covfile,PROCDR=SURVEYLOGISTIC,OUTPUT=dataset);

*exposure and perceived risk of mj use 1x month;
```

```
proc surveylogistic data=nsduh2014;
      stratum vestr;
      cluster verep;
      weight analwt_c;
      class RSKMJOCC (ref='1') / param=ref order=internal;
      model mrjmon (event='1') = SPDMON RSKMJOCC/ covB;
      ods output surveylogistic.covb=covfile;
run;
%Collin(COVDSN=covfile,PROCDR=SURVEYLOGISTIC,OUTPUT=dataset);

*exposure and perceived risk of mj use 1x week;;
proc surveylogistic data=nsduh2014;
      stratum vestr;
      cluster verep;
      weight analwt_c;
      class RSKMJREG (ref='1') / param=ref order=internal;
      model mrjmon (event='1') = SPDMON RSKMJREG/ covB;
      ods output surveylogistic.covb=covfile;
run;
%Collin(COVDSN=covfile,PROCDR=SURVEYLOGISTIC,OUTPUT=dataset);

*exposure and perceived risk of mj use 1x month, perceived risk of mj use 1x week;;
proc surveylogistic data=nsduh2014;
      stratum vestr;
      cluster verep;
      weight analwt_c;
      class RSKMJOCC (ref='1') RSKMJREG (ref='1') / param=ref order=internal;
      model mrjmon (event='1') = SPDMON RSKMJOCC RSKMJREG/ covB;
      ods output surveylogistic.covb=covfile;
run;
%Collin(COVDSN=covfile,PROCDR=SURVEYLOGISTIC,OUTPUT=dataset);

*exposure, MJ dependence, perceived risk of mj use 1x month, perceived risk of mj use 1x week;;
proc surveylogistic data=nsduh2014;
      stratum vestr;
      cluster verep;
      weight analwt_c;
      class RSKMJOCC (ref='1') RSKMJREG (ref='1') / param=ref order=internal;
      model mrjmon (event='1') = SPDMON RSKMJOCC RSKMJREG DEPNDMRJ/ covB;
      ods output surveylogistic.covb=covfile;
run;
```

```
%Collin(COVDSN=covfile,PROCDR=SURVEYLOGISTIC,OUTPUT=dataset);

*exposure past month cigarette use;
proc surveylogistic data=nsduh2014;
      stratum vestr;
      cluster verep;
      weight analwt_c;
      model mrjmon (event='1') = SPDMON CIGMON/ covB;
      ods output surveylogistic.covb=covfile;
run;
%Collin(COVDSN=covfile,PROCDR=SURVEYLOGISTIC,OUTPUT=dataset);

*exposure past year cigarette use;
proc surveylogistic data=nsduh2014;
      stratum vestr;
      cluster verep;
      weight analwt_c;
      model mrjmon (event='1') = SPDMON CIGYR/ covB;
      ods output surveylogistic.covb=covfile;
run;
%Collin(COVDSN=covfile,PROCDR=SURVEYLOGISTIC,OUTPUT=dataset);

*exposure past year cigarette use;
proc surveylogistic data=nsduh2014;
      stratum vestr;
      cluster verep;
      weight analwt_c;
      model mrjmon (event='1') = SPDMON CIGMON CIGYR/ covB;
      ods output surveylogistic.covb=covfile;
run;
%Collin(COVDSN=covfile,PROCDR=SURVEYLOGISTIC,OUTPUT=dataset);


*exposure, perceived risk of mj use 1x month, perceived risk of mj use 1x week, past month cig, past year
cig;
proc surveylogistic data=nsduh2014;
      stratum vestr;
      cluster verep;
      weight analwt_c;
      class RSKMJOCC (ref='1') RSKMJREG (ref='1') / param=ref order=internal;
      model mrjmon (event='1') = SPDMON RSKMJOCC RSKMJREG CIGYR CIGMON/covb;
```

```
        where 1<=RSKMJREG<=3;
        ods output surveylogistic.covb=covfile;
run;
%Collin(COVDSN=covfile,PROCDR=SURVEYLOGISTIC,OUTPUT=dataset);
*RSKMJREG=4 CI LL= <0.001 so only include responses 1-3;

*exposure and past month nicotine dependence;
proc surveylogistic data=nsduh2014;
        stratum vestr;
        cluster verep;
        weight analwt_c;
        model mrjmon (event='1') = SPDMON DNICNSP/covb;
        ods output surveylogistic.covb=covfile;
run;
%Collin(COVDSN=covfile,PROCDR=SURVEYLOGISTIC,OUTPUT=dataset);


*exposure, perceived risk of mj use 1x month, perceived risk of mj use 1x week, past month cig, past year
cig, nicotine dependence;
proc surveylogistic data=nsduh2014;
        stratum vestr;
        cluster verep;
        weight analwt_c;
        class RSKMJOCC (ref='1') RSKMJREG (ref='1') / param=ref order=internal;
        model mrjmon (event='1') = SPDMON RSKMJOCC RSKMJREG CIGYR CIGMON DNICNSP/covb;
        where 1<=RSKMJREG<=3;
        ods output surveylogistic.covb=covfile;
run;
%Collin(COVDSN=covfile,PROCDR=SURVEYLOGISTIC,OUTPUT=dataset);


**********************************
* SOCIODEMOGRAPHIC + SUBSTANCE USE *
**********************************;

proc surveylogistic data=nsduh2014;
        stratum vestr;
        cluster verep;
        weight analwt_c;
        class TRIMEST (ref='1') CATAGE (ref='2') RACE (ref='1') INCOME (ref='1') IRMARIT (ref='1')
SNRLGIMP(ref='1') RSKMJOCC (ref='1') RSKMJREG (ref='1') / param=ref order=internal;
        model mrjmon (event='1') = SPDMON TRIMEST CATAGE RACE IRMARIT INCOME SNRLGIMP RSKMJOCC RSKMJREG CIGYR
CIGMON DNICNSP/covb;
```

```
      where 1<=RSKMJREG<=3;
      ods output surveylogistic.covb=covfile;
run;
%Collin(COVDSN=covfile,PROCDR=SURVEYLOGISTIC,OUTPUT=dataset);


*****************************
*          MENTAL HEALTH    *
****************************;

*exposure and anxiety in lifetime;
proc surveylogistic data=nsduh2014;
      stratum vestr;
      cluster verep;
      weight analwt_c;
      model mrjmon (event='1') = SPDMON ANXDLIF/covb;
      ods output surveylogistic.covb=covfile;
run;
%Collin(COVDSN=covfile,PROCDR=SURVEYLOGISTIC,OUTPUT=dataset);


*exposure and anxiety in past year;
proc surveylogistic data=nsduh2014;
      stratum vestr;
      cluster verep;
      weight analwt_c;
      model mrjmon (event='1') = SPDMON ANXDYR/covb;
      ods output surveylogistic.covb=covfile;
run;
%Collin(COVDSN=covfile,PROCDR=SURVEYLOGISTIC,OUTPUT=dataset);


*exposure and depression in past year and lifetime;
proc surveylogistic data=nsduh2014;
      stratum vestr;
      cluster verep;
      weight analwt_c;
      model mrjmon (event='1') = SPDMON DEPRSLIF/covb;
      ods output surveylogistic.covb=covfile;
run;
%Collin(COVDSN=covfile,PROCDR=SURVEYLOGISTIC,OUTPUT=dataset);


*exposure and depression in past year and lifetime;
proc surveylogistic data=nsduh2014;
```

```
        stratum vestr;
        cluster verep;
        weight analwt_c;
        model mrjmon (event='1') = SPDMON DEPRSYR/covb;
        ods output surveylogistic.covb=covfile;
run;
%Collin(COVDSN=covfile,PROCDR=SURVEYLOGISTIC,OUTPUT=dataset);


*exposure and depression in past year and lifetime;
proc surveylogistic data=nsduh2014;
        stratum vestr;
        cluster verep;
        weight analwt_c;
        model mrjmon (event='1') = SPDMON DEPRSLIF DEPRSYR/covb;
        ods output surveylogistic.covb=covfile;
run;
%Collin(COVDSN=covfile,PROCDR=SURVEYLOGISTIC,OUTPUT=dataset);


*exposure, anxiety and depression in past year and lifetime;
proc surveylogistic data=nsduh2014;
        stratum vestr;
        cluster verep;
        weight analwt_c;
        model mrjmon (event='1') = SPDMON ANXDYR ANXDLIF DEPRSLIF DEPRSYR/covb;
        ods output surveylogistic.covb=covfile;
run;
%Collin(COVDSN=covfile,PROCDR=SURVEYLOGISTIC,OUTPUT=dataset);


*exposure and past year serious psyc distress;
proc surveylogistic data=nsduh2014;
        stratum vestr;
        cluster verep;
        weight analwt_c;
        model mrjmon (event='1') = SPDMON SPDYR/covb;
        ods output surveylogistic.covb=covfile;
run;
%Collin(COVDSN=covfile,PROCDR=SURVEYLOGISTIC,OUTPUT=dataset);


*exposure, anxiety and depression in past year and lifetime, past year serious psyc distress;
proc surveylogistic data=nsduh2014;
        stratum vestr;
```

```
        cluster verep;
        weight analwt_c;
        model mrjmon (event='1') = SPDMON ANXDYR ANXDLIF DEPRSLIF DEPRSYR SPDYR/covb;
        ods output surveylogistic.covb=covfile;
run;
%Collin(COVDSN=covfile,PROCDR=SURVEYLOGISTIC,OUTPUT=dataset);


*exposure and mental illness category;
proc surveylogistic data=nsduh2014;
        stratum vestr;
        cluster verep;
        weight analwt_c;
        class MI_CAT_U (ref='0') / param=ref order=internal;
        model mrjmon (event='1') = SPDMON MI_CAT_U/covb;
        ods output surveylogistic.covb=covfile;
run;
%Collin(COVDSN=covfile,PROCDR=SURVEYLOGISTIC,OUTPUT=dataset);


*exposure, anxiety and depression in past year and lifetime, past year serious psyc distress;
proc surveylogistic data=nsduh2014;
        stratum vestr;
        cluster verep;
        weight analwt_c;
        class MI_CAT_U (ref='0') / param=ref order=internal;
        model mrjmon (event='1') = SPDMON ANXDYR ANXDLIF DEPRSLIF DEPRSYR SPDYR MI_CAT_U/covb;
        ods output surveylogistic.covb=covfile;
run;
%Collin(COVDSN=covfile,PROCDR=SURVEYLOGISTIC,OUTPUT=dataset);



*****************************
*           FULL MODEL          *
****************************;
*model without interaction and without DEPNDMRJ & IRMJFM;
proc surveylogistic data=nsduh2014;
        stratum vestr;
        cluster verep;
        weight analwt_c;
        class TRIMEST (ref='1') CATAGE (ref='2') RACE (ref='1') INCOME (ref='1') IRMARIT (ref='1')
SNRLGIMP(ref='1') RSKMJOCC (ref='1') RSKMJREG (ref='1') MI_CAT_U (ref='0')  / param=ref order=internal;
```

```sas
        model mrjmon (event='1') = SPDMON TRIMEST CATAGE RACE IRMARIT INCOME SNRLGIMP RSKMJOCC RSKMJREG CIGYR
CIGMON DNICNSP ANXDYR ANXDLIF DEPRSLIF DEPRSYR SPDYR MI_CAT_U/ covb;
        where 1<=RSKMJREG<=3;
        ods output surveylogistic.covb=covfile;
run;
%Collin(COVDSN=covfile,PROCDR=SURVEYLOGISTIC,OUTPUT=dataset);

*model with interactions;
proc surveylogistic data=nsduh2014;
        stratum vestr;
        cluster verep;
        weight analwt_c;
        class TRIMEST (ref='1') CATAGE (ref='2') RACE (ref='1') INCOME (ref='1') IRMARIT (ref='1')
SNRLGIMP(ref='1') RSKMJOCC (ref='1') RSKMJREG (ref='1') MI_CAT_U (ref='0')  / param=ref order=internal;
        model mrjmon (event='1') = SPDMON TRIMEST CATAGE RACE IRMARIT INCOME SNRLGIMP RSKMJOCC RSKMJREG CIGYR
CIGMON DNICNSP ANXDYR ANXDLIF DEPRSLIF DEPRSYR SPDYR MI_CAT_U
                                          SPDMON_CATAGE SPDMON_IRMARIT SPDMON_ANXDYR SPDMON_DEPRSYR
SPDMON_MICATU SPDMON_RSKMJOCC SPDMON_RSKMJREG SPDMON_INCOME/ covb;
        where 1<=RSKMJREG<=3;
        ods output surveylogistic.covb=covfile;
run;
%Collin(COVDSN=covfile,PROCDR=SURVEYLOGISTIC,OUTPUT=dataset);
*SPDMON_IRMARIT 0.99 ;

*drop SPDMON_IRMARIT;
proc surveylogistic data=nsduh2014;
        stratum vestr;
        cluster verep;
        weight analwt_c;
        class TRIMEST (ref='1') CATAGE (ref='2') RACE (ref='1') INCOME (ref='1') IRMARIT (ref='1')
SNRLGIMP(ref='1') RSKMJOCC (ref='1') RSKMJREG (ref='1') MI_CAT_U (ref='0')  / param=ref order=internal;
        model mrjmon (event='1') = SPDMON TRIMEST CATAGE RACE IRMARIT INCOME SNRLGIMP RSKMJOCC RSKMJREG CIGYR
CIGMON DNICNSP ANXDYR ANXDLIF DEPRSLIF DEPRSYR SPDYR MI_CAT_U
                                          SPDMON_CATAGE SPDMON_ANXDYR SPDMON_DEPRSYR SPDMON_MICATU
SPDMON_RSKMJOCC SPDMON_RSKMJREG SPDMON_INCOME/ covb;
        where 1<=RSKMJREG<=3;
        ods output surveylogistic.covb=covfile;
run;
%Collin(COVDSN=covfile,PROCDR=SURVEYLOGISTIC,OUTPUT=dataset);
*SPDMON_INCOME 0.872 ;
```

```
*drop SPDMON_INCOME;
proc surveylogistic data=nsduh2014;
      stratum vestr;
      cluster verep;
      weight analwt_c;
      class TRIMEST (ref='1') CATAGE (ref='2') RACE (ref='1') INCOME (ref='1') IRMARIT (ref='1')
SNRLGIMP(ref='1') RSKMJOCC (ref='1') RSKMJREG (ref='1') MI_CAT_U (ref='0')  / param=ref order=internal;
      model mrjmon (event='1') = SPDMON TRIMEST CATAGE RACE IRMARIT INCOME SNRLGIMP RSKMJOCC RSKMJREG CIGYR
CIGMON DNICNSP ANXDYR ANXDLIF DEPRSLIF DEPRSYR SPDYR MI_CAT_U
                                            SPDMON_CATAGE SPDMON_ANXDYR SPDMON_DEPRSYR SPDMON_MICATU
SPDMON_RSKMJOCC SPDMON_RSKMJREG/ covb;
      where 1<=RSKMJREG<=3;
      ods output surveylogistic.covb=covfile;
run;
%Collin(COVDSN=covfile,PROCDR=SURVEYLOGISTIC,OUTPUT=dataset);
*SPDMON_RSKMJREG 0.864 ;

*drop SPDMON_RSKMJREG;
proc surveylogistic data=nsduh2014;
      stratum vestr;
      cluster verep;
      weight analwt_c;
      class TRIMEST (ref='1') CATAGE (ref='2') RACE (ref='1') INCOME (ref='1') IRMARIT (ref='1')
SNRLGIMP(ref='1') RSKMJOCC (ref='1') RSKMJREG (ref='1') MI_CAT_U (ref='0')  / param=ref order=internal;
      model mrjmon (event='1') = SPDMON TRIMEST CATAGE RACE IRMARIT INCOME SNRLGIMP RSKMJOCC RSKMJREG CIGYR
CIGMON DNICNSP ANXDYR ANXDLIF DEPRSLIF DEPRSYR SPDYR MI_CAT_U
                                            SPDMON_CATAGE SPDMON_ANXDYR SPDMON_DEPRSYR SPDMON_MICATU
SPDMON_RSKMJOCC / covb;
      where 1<=RSKMJREG<=3;
      ods output surveylogistic.covb=covfile;
run;
%Collin(COVDSN=covfile,PROCDR=SURVEYLOGISTIC,OUTPUT=dataset);
*RSKMJREG3 0.660;
*SPDYR 0.507;

*drop SPDYR;
proc surveylogistic data=nsduh2014;
      stratum vestr;
      cluster verep;
      weight analwt_c;
```

```sas
      class TRIMEST (ref='1') CATAGE (ref='2') RACE (ref='1') INCOME (ref='1') IRMARIT (ref='1')
SNRLGIMP(ref='1') RSKMJOCC (ref='1') RSKMJREG (ref='1') MI_CAT_U (ref='0')  / param=ref order=internal;
      model mrjmon (event='1') = SPDMON TRIMEST CATAGE RACE IRMARIT INCOME SNRLGIMP RSKMJOCC RSKMJREG CIGYR
CIGMON DNICNSP ANXDYR ANXDLIF DEPRSLIF DEPRSYR  MI_CAT_U
                                              SPDMON_CATAGE SPDMON_ANXDYR SPDMON_DEPRSYR SPDMON_MICATU
SPDMON_RSKMJOCC / covb;
      where 1<=RSKMJREG<=3;
      ods output surveylogistic.covb=covfile;
run;
%Collin(COVDSN=covfile,PROCDR=SURVEYLOGISTIC,OUTPUT=dataset);
*SPDMON_CATAGE 0.678 ;

*drop SPDMON_CATAGE;
proc surveylogistic data=nsduh2014;
      stratum vestr;
      cluster verep;
      weight analwt_c;
      class TRIMEST (ref='1') CATAGE (ref='2') RACE (ref='1') INCOME (ref='1') IRMARIT (ref='1')
SNRLGIMP(ref='1') RSKMJOCC (ref='1') RSKMJREG (ref='1') MI_CAT_U (ref='0')  / param=ref order=internal;
      model mrjmon (event='1') = SPDMON TRIMEST CATAGE RACE IRMARIT INCOME SNRLGIMP RSKMJOCC RSKMJREG CIGYR
CIGMON DNICNSP ANXDYR ANXDLIF DEPRSLIF DEPRSYR  MI_CAT_U
                                              SPDMON_ANXDYR SPDMON_DEPRSYR SPDMON_MICATU SPDMON_RSKMJOCC /
covb;
      where 1<=RSKMJREG<=3;
      ods output surveylogistic.covb=covfile;
run;
%Collin(COVDSN=covfile,PROCDR=SURVEYLOGISTIC,OUTPUT=dataset);
*INCOME2 0.6025 ;
*SPDMON_ANXDYR 0.4815;

*drop INCOME;
proc surveylogistic data=nsduh2014;
      stratum vestr;
      cluster verep;
      weight analwt_c;
      class TRIMEST (ref='1') CATAGE (ref='2') RACE (ref='1') INCOME (ref='1') IRMARIT (ref='1')
SNRLGIMP(ref='1') RSKMJOCC (ref='1') RSKMJREG (ref='1') MI_CAT_U (ref='0')  / param=ref order=internal;
      model mrjmon (event='1') = SPDMON TRIMEST CATAGE RACE IRMARIT SNRLGIMP RSKMJOCC RSKMJREG CIGYR CIGMON
DNICNSP ANXDYR ANXDLIF DEPRSLIF DEPRSYR  MI_CAT_U
                                              SPDMON_ANXDYR SPDMON_DEPRSYR SPDMON_MICATU SPDMON_RSKMJOCC /
covb;
```

```
        where 1<=RSKMJREG<=3;
        ods output surveylogistic.covb=covfile;
run;
%Collin(COVDSN=covfile,PROCDR=SURVEYLOGISTIC,OUTPUT=dataset);
*SPDMON_ANXDYR 0.588;

*drop SPDMON_ANXDYR;
proc surveylogistic data=nsduh2014;
        stratum vestr;
        cluster verep;
        weight analwt_c;
        class TRIMEST (ref='1') CATAGE (ref='2') RACE (ref='1') INCOME (ref='1') IRMARIT (ref='1')
SNRLGIMP(ref='1') RSKMJOCC (ref='1') RSKMJREG (ref='1') MI_CAT_U (ref='0')  / param=ref order=internal;
        model mrjmon (event='1') = SPDMON TRIMEST CATAGE RACE IRMARIT SNRLGIMP RSKMJOCC RSKMJREG CIGYR CIGMON
DNICNSP ANXDYR ANXDLIF DEPRSLIF DEPRSYR  MI_CAT_U
                                        SPDMON_DEPRSYR SPDMON_MICATU SPDMON_RSKMJOCC / covb;
        where 1<=RSKMJREG<=3;
        ods output surveylogistic.covb=covfile;
run;
%Collin(COVDSN=covfile,PROCDR=SURVEYLOGISTIC,OUTPUT=dataset);
*MI_CAT_U3 0.5496;
*ANXDYR 0.5206 ;

*drop MI_CAT_U & interaction;
proc surveylogistic data=nsduh2014;
        stratum vestr;
        cluster verep;
        weight analwt_c;
        class TRIMEST (ref='1') CATAGE (ref='2') RACE (ref='1') INCOME (ref='1') IRMARIT (ref='1')
SNRLGIMP(ref='1') RSKMJOCC (ref='1') RSKMJREG (ref='1') / param=ref order=internal;
        model mrjmon (event='1') = SPDMON TRIMEST CATAGE RACE IRMARIT SNRLGIMP RSKMJOCC RSKMJREG CIGYR CIGMON
DNICNSP ANXDYR ANXDLIF DEPRSLIF DEPRSYR
                                        SPDMON_DEPRSYR SPDMON_RSKMJOCC / covb;
        where 1<=RSKMJREG<=3;
        ods output surveylogistic.covb=covfile;
run;
%Collin(COVDSN=covfile,PROCDR=SURVEYLOGISTIC,OUTPUT=dataset);
*IRMARIT4 0.8163;

*drop IRMARIT;
proc surveylogistic data=nsduh2014;
```

```
      stratum vestr;
      cluster verep;
      weight analwt_c;
      class TRIMEST (ref='1') CATAGE (ref='2') RACE (ref='1') INCOME (ref='1') SNRLGIMP(ref='1') RSKMJOCC
(ref='1') RSKMJREG (ref='1') / param=ref order=internal;
      model mrjmon (event='1') = SPDMON TRIMEST CATAGE RACE SNRLGIMP RSKMJOCC RSKMJREG CIGYR CIGMON DNICNSP
ANXDYR ANXDLIF DEPRSLIF DEPRSYR
                                          SPDMON_DEPRSYR SPDMON_RSKMJOCC / covb;
      where 1<=RSKMJREG<=3;
      ods output surveylogistic.covb=covfile;
run;
%Collin(COVDSN=covfile,PROCDR=SURVEYLOGISTIC,OUTPUT=dataset);
*SPDMON_RSKMJOCC 0.6399;

*drop SPDMON_RSKMJOCC;
proc surveylogistic data=nsduh2014;
      stratum vestr;
      cluster verep;
      weight analwt_c;
      class TRIMEST (ref='1') CATAGE (ref='2') RACE (ref='1') INCOME (ref='1') SNRLGIMP(ref='1') RSKMJOCC
(ref='1') RSKMJREG (ref='1') / param=ref order=internal;
      model mrjmon (event='1') = SPDMON TRIMEST CATAGE RACE SNRLGIMP RSKMJOCC RSKMJREG CIGYR CIGMON DNICNSP
ANXDYR ANXDLIF DEPRSLIF DEPRSYR
                                          SPDMON_DEPRSYR / covb;
      where 1<=RSKMJREG<=3;
      ods output surveylogistic.covb=covfile;
run;
%Collin(COVDSN=covfile,PROCDR=SURVEYLOGISTIC,OUTPUT=dataset);
*ANXDLIF 0.9032;

*drop ANXDLIF;
proc surveylogistic data=nsduh2014;
      stratum vestr;
      cluster verep;
      weight analwt_c;
      class TRIMEST (ref='1') CATAGE (ref='2') RACE (ref='1') INCOME (ref='1') SNRLGIMP(ref='1') RSKMJOCC
(ref='1') RSKMJREG (ref='1') / param=ref order=internal;
      model mrjmon (event='1') = SPDMON TRIMEST CATAGE RACE SNRLGIMP RSKMJOCC RSKMJREG CIGYR CIGMON DNICNSP
ANXDYR DEPRSLIF DEPRSYR
                                          SPDMON_DEPRSYR / covb;
      where 1<=RSKMJREG<=3;
```

```sas
        ods output surveylogistic.covb=covfile;
run;
%Collin(COVDSN=covfile,PROCDR=SURVEYLOGISTIC,OUTPUT=dataset);
*RSKMJOCC2 0.8361 ;

*drop RSKMJOCC;
proc surveylogistic data=nsduh2014;
        stratum vestr;
        cluster verep;
        weight analwt_c;
        class TRIMEST (ref='1') CATAGE (ref='2') RACE (ref='1') INCOME (ref='1') SNRLGIMP(ref='1')RSKMJREG
(ref='1') / param=ref order=internal;
        model mrjmon (event='1') = SPDMON TRIMEST CATAGE RACE SNRLGIMP RSKMJREG CIGYR CIGMON DNICNSP ANXDYR
DEPRSLIF DEPRSYR
                                        SPDMON_DEPRSYR / covb;
        where 1<=RSKMJREG<=3;
        ods output surveylogistic.covb=covfile;
run;
%Collin(COVDSN=covfile,PROCDR=SURVEYLOGISTIC,OUTPUT=dataset);
*CONDINDX 15.0913 ;

                *COLLINEARITY RESULTS: exposure + 11 variables + 1 interaction;
```

```
*********************************************************************
*              S T E P   B Y   S T E P   R E G R E S S I O N            *
********************************************************************;

*exposure only;
proc surveylogistic data=nsduh2014;
      stratum vestr;
      cluster verep;
      weight analwt_c;
      model mrjmon (event='1') = SPDMON;
run;

**********************
* SOCIODEMOGRAPHIC   *
*********************;

*with trimester;
proc surveylogistic data=nsduh2014;
      stratum vestr;
      cluster verep;
      weight analwt_c;
      class TRIMEST (ref='1') / param=ref order=internal;
      model mrjmon (event='1') = SPDMON TRIMEST;
run;

*with age;
proc surveylogistic data=nsduh2014;
      stratum vestr;
      cluster verep;
      weight analwt_c;
      class CATAGE (ref='2') / param=ref order=internal;
      model mrjmon (event='1') = SPDMON CATAGE;
```

```
run;

*with trimester and age;
proc surveylogistic data=nsduh2014;
      stratum vestr;
      cluster verep;
      weight analwt_c;
      class CATAGE (ref='2') TRIMEST (ref='1') / param=ref order=internal;
      model mrjmon (event='1') = SPDMON TRIMEST CATAGE;
run;

*with Race;
proc surveylogistic data=nsduh2014;
      stratum vestr;
      cluster verep;
      weight analwt_c;
      class RACE (ref='1') / param=ref order=internal;
      model mrjmon (event='1') = SPDMON RACE;
run;

*with Income;
proc surveylogistic data=nsduh2014;
      stratum vestr;
      cluster verep;
      weight analwt_c;
      class INCOME (ref='1') / param=ref order=internal;
      model mrjmon (event='1') = SPDMON INCOME;
run;

*with marital status;
proc surveylogistic data=nsduh2014;
      stratum vestr;
      cluster verep;
      weight analwt_c;
      class IRMARIT (ref='1') / param=ref order=internal;
      model mrjmon (event='1') = SPDMON IRMARIT;
run;

*with race and income status;
proc surveylogistic data=nsduh2014;
      stratum vestr;
```

```sas
        cluster verep;
        weight analwt_c;
        class RACE (ref='1') INCOME (ref='1') / param=ref order=internal;
        model mrjmon (event='1') = SPDMON RACE INCOME;
run;

*with race and marital status;
proc surveylogistic data=nsduh2014;
        stratum vestr;
        cluster verep;
        weight analwt_c;
        class RACE (ref='1') IRMARIT (ref='1') / param=ref order=internal;
        model mrjmon (event='1') = SPDMON RACE IRMARIT;
run;

*with income and marital status;
proc surveylogistic data=nsduh2014;
        stratum vestr;
        cluster verep;
        weight analwt_c;
        class INCOME (ref='1') IRMARIT (ref='1') / param=ref order=internal;
        model mrjmon (event='1') = SPDMON IRMARIT INCOME;
run;

*with race income and marital status;
proc surveylogistic data=nsduh2014;
        stratum vestr;
        cluster verep;
        weight analwt_c;
        class RACE (ref='1') INCOME (ref='1') IRMARIT (ref='1') / param=ref order=internal;
        model mrjmon (event='1') = SPDMON RACE IRMARIT INCOME;
run;

*with trimester, race income and marital status;
proc surveylogistic data=nsduh2014;
        stratum vestr;
        cluster verep;
        weight analwt_c;
        class TRIMEST (ref='1') RACE (ref='1') INCOME (ref='1') IRMARIT (ref='1') / param=ref order=internal;
        model mrjmon (event='1') = SPDMON TRIMEST RACE IRMARIT INCOME;
run;
```

```
*with age, race income and marital status;
proc surveylogistic data=nsduh2014;
      stratum vestr;
      cluster verep;
      weight analwt_c;
      class CATAGE (ref='2') RACE (ref='1') INCOME (ref='1') IRMARIT (ref='1') / param=ref order=internal;
      model mrjmon (event='1') = SPDMON CATAGE RACE IRMARIT INCOME;
run;


*with trimester, age, race income and marital status;
proc surveylogistic data=nsduh2014;
      stratum vestr;
      cluster verep;
      weight analwt_c;
      class TRIMEST (ref='1') CATAGE (ref='2') RACE (ref='1') INCOME (ref='1') IRMARIT (ref='1') /
param=ref order=internal;
      model mrjmon (event='1') = SPDMON TRIMEST CATAGE RACE IRMARIT INCOME;
run;

*with religious beliefs;
proc surveylogistic data=nsduh2014;
      stratum vestr;
      cluster verep;
      weight analwt_c;
      class SNRLGIMP(ref='1') / param=ref order=internal;
      model mrjmon (event='1') = SPDMON SNRLGIMP;
run;

*with trimester, age, race income marital status, and religious beliefs;
proc surveylogistic data=nsduh2014;
      stratum vestr;
      cluster verep;
      weight analwt_c;
      class TRIMEST (ref='1') CATAGE (ref='2') RACE (ref='1') INCOME (ref='1') IRMARIT (ref='1')
SNRLGIMP(ref='1') / param=ref order=internal;
      model mrjmon (event='1') = SPDMON TRIMEST CATAGE RACE IRMARIT INCOME SNRLGIMP;
run;


****************************
```

```
* SUBSTANCE USE & ATTITUDES  *
*****************************;

*with marijuana dependence;
proc surveylogistic data=nsduh2014;
      stratum vestr;
      cluster verep;
      weight analwt_c;
      model mrjmon (event='1') = SPDMON DEPNDMRJ;
run;

*with perceived risk of mj use 1x month;
proc surveylogistic data=nsduh2014;
      stratum vestr;
      cluster verep;
      weight analwt_c;
      class RSKMJOCC (ref='1') / param=ref order=internal;
      model mrjmon (event='1') = SPDMON RSKMJOCC;
run;

*with perceived risk of mj use 1x week;
proc surveylogistic data=nsduh2014;
      stratum vestr;
      cluster verep;
      weight analwt_c;
      class RSKMJREG (ref='1') / param=ref order=internal;
      model mrjmon (event='1') = SPDMON RSKMJREG;
run;

*exposure and perceived risk of mj use 1x month, perceived risk of mj use 1x week;;
proc surveylogistic data=nsduh2014;
      stratum vestr;
      cluster verep;
      weight analwt_c;
      class RSKMJOCC (ref='1') RSKMJREG (ref='1') / param=ref order=internal;
      model mrjmon (event='1') = SPDMON RSKMJOCC RSKMJREG;
run;

*exposure, dependence MJ, and perceived risk of mj use 1x month, perceived risk of mj use 1x week;;
proc surveylogistic data=nsduh2014;
      stratum vestr;
```

```
        cluster verep;
        weight analwt_c;
        class RSKMJOCC (ref='1') RSKMJREG (ref='1') / param=ref order=internal;
        model mrjmon (event='1') = SPDMON RSKMJOCC RSKMJREG DEPNDMRJ;
run;
*DEPNDMRJ OR=42.284, CI UL = >999
*drop this variable for future analysis;


*with past month cigarette use;
proc surveylogistic data=nsduh2014;
        stratum vestr;
        cluster verep;
        weight analwt_c;
        model mrjmon (event='1') = SPDMON CIGMON;
run;


*with past year cigarette use;
proc surveylogistic data=nsduh2014;
        stratum vestr;
        cluster verep;
        weight analwt_c;
        model mrjmon (event='1') = SPDMON CIGYR;
run;


*with past year and past month cigarette use;
proc surveylogistic data=nsduh2014;
        stratum vestr;
        cluster verep;
        weight analwt_c;
        model mrjmon (event='1') = SPDMON CIGMON CIGYR;
run;


*exposure, and perceived risk of mj use 1x month, perceived risk of mj use 1x week, past month cig, past
year cig;
proc surveylogistic data=nsduh2014;
        stratum vestr;
        cluster verep;
        weight analwt_c;
        class RSKMJOCC (ref='1') RSKMJREG (ref='1') / param=ref order=internal;
        model mrjmon (event='1') = SPDMON RSKMJOCC RSKMJREG CIGYR CIGMON;
```

```
        where 1<=RSKMJREG<=3;
run;
*RSKMJREG=4 CI LL= <0.001 so only include responses 1-3;

*exposure and past month nicotine dependence;
proc surveylogistic data=nsduh2014;
        stratum vestr;
        cluster verep;
        weight analwt_c;
        model mrjmon (event='1') = SPDMON DNICNSP;
run;

*exposure, and perceived risk of mj use 1x month, perceived risk of mj use 1x week, past month cig, past
year cig, past month nicotine dependence;
proc surveylogistic data=nsduh2014;
        stratum vestr;
        cluster verep;
        weight analwt_c;
        class RSKMJOCC (ref='1') RSKMJREG (ref='1') / param=ref order=internal;
        model mrjmon (event='1') = SPDMON RSKMJOCC RSKMJREG CIGYR CIGMON DNICNSP;
        where 1<=RSKMJREG<=3;
run;

*exposure trimester, age, race income marital status, and religious beliefs and perceived risk of mj use 1x
month, perceived risk of mj use 1x week, past month cig, past year cig, past month nicotine dependence;
proc surveylogistic data=nsduh2014;
        stratum vestr;
        cluster verep;
        weight analwt_c;
        class TRIMEST (ref='1') CATAGE (ref='2') RACE (ref='1') INCOME (ref='1') IRMARIT (ref='1')
SNRLGIMP(ref='1') RSKMJOCC (ref='1') RSKMJREG (ref='1') / param=ref order=internal;
        model mrjmon (event='1') = SPDMON TRIMEST CATAGE RACE IRMARIT INCOME SNRLGIMP RSKMJOCC RSKMJREG CIGYR
CIGMON DNICNSP;
        where 1<=RSKMJREG<=3;
run;
*RSKMJREG 3 vs 1 CI LL <0.001;
*RSKMJOCC has crazy wide CI's;
*INCOME, IRMARIT, AND CIGMON also have wide CI's;
```

```
*****************************
*      MENTAL HEALTH        *
*****************************;


*exposure and anxiety in lifetime;
proc surveylogistic data=nsduh2014;
      stratum vestr;
      cluster verep;
      weight analwt_c;
      model mrjmon (event='1') = SPDMON ANXDLIF;
run;


*exposure and anxiety in past year;
proc surveylogistic data=nsduh2014;
      stratum vestr;
      cluster verep;
      weight analwt_c;
      model mrjmon (event='1') = SPDMON ANXDYR;
run;


*exposure and anxiety in past year and lifetime;
proc surveylogistic data=nsduh2014;
      stratum vestr;
      cluster verep;
      weight analwt_c;
      model mrjmon (event='1') = SPDMON ANXDYR ANXDLIF;
run;


*exposure and depression in lifetime;
proc surveylogistic data=nsduh2014;
      stratum vestr;
      cluster verep;
      weight analwt_c;
      model mrjmon (event='1') = SPDMON DEPRSLIF;
run;


*exposure and depression in past year;
proc surveylogistic data=nsduh2014;
      stratum vestr;
      cluster verep;
      weight analwt_c;
```

```
        model mrjmon (event='1') = SPDMON DEPRSYR;
run;


*exposure and depression in past year and lifetime;
proc surveylogistic data=nsduh2014;
        stratum vestr;
        cluster verep;
        weight analwt_c;
        model mrjmon (event='1') = SPDMON DEPRSLIF DEPRSYR;
run;


*exposure, anxietye and depression in past year and lifetime;
proc surveylogistic data=nsduh2014;
        stratum vestr;
        cluster verep;
        weight analwt_c;
        model mrjmon (event='1') = SPDMON ANXDYR ANXDLIF DEPRSLIF DEPRSYR;
run;


*exposure and serious psyc distress past year;
proc surveylogistic data=nsduh2014;
        stratum vestr;
        cluster verep;
        weight analwt_c;
        model mrjmon (event='1') = SPDMON SPDYR;
run;


*exposure, anxietye and depression in past year and lifetime;
proc surveylogistic data=nsduh2014;
        stratum vestr;
        cluster verep;
        weight analwt_c;
        model mrjmon (event='1') = SPDMON ANXDYR ANXDLIF DEPRSLIF DEPRSYR SPDYR;
run;


*exposure and mental illness categorical;
proc surveylogistic data=nsduh2014;
        stratum vestr;
        cluster verep;
        weight analwt_c;
        class MI_CAT_U (ref='0') / param=ref order=internal;
```

```
      model mrjmon (event='1') = SPDMON MI_CAT_U;
run;


*exposure and anxietye and depression in past year and lifetime, mental illness categorical;
proc surveylogistic data=nsduh2014;
      stratum vestr;
      cluster verep;
      weight analwt_c;
      class MI_CAT_U (ref='0') / param=ref order=internal;
      model mrjmon (event='1') = SPDMON MI_CAT_U ANXDYR ANXDLIF DEPRSLIF DEPRSYR SPDYR;
run;



*****************************
*          FULL MODEL       *
*****************************;


*model without interaction and without DEPNDMRJ & IRMJFM;
proc surveylogistic data=nsduh2014;
      stratum vestr;
      cluster verep;
      weight analwt_c;
      class TRIMEST (ref='1') CATAGE (ref='2') RACE (ref='1') INCOME (ref='1') IRMARIT (ref='1')
SNRLGIMP(ref='1') RSKMJOCC (ref='1') RSKMJREG (ref='1') MI_CAT_U (ref='0')/ param=ref order=internal;
      model mrjmon (event='1') = SPDMON TRIMEST CATAGE RACE IRMARIT INCOME SNRLGIMP RSKMJOCC RSKMJREG CIGYR
CIGMON DNICNSP ANXDYR ANXDLIF DEPRSLIF DEPRSYR SPDYR MI_CAT_U;
      where 1<=RSKMJREG<=3;
run;


*model with all interactions of interest;
proc surveylogistic data=nsduh2014;
      stratum vestr;
      cluster verep;
      weight analwt_c;
      class TRIMEST (ref='1') CATAGE (ref='2') RACE (ref='1') INCOME (ref='1') IRMARIT (ref='1')
SNRLGIMP(ref='1') RSKMJOCC (ref='1') RSKMJREG (ref='1') MI_CAT_U (ref='0') / param=ref order=internal;
      model mrjmon (event='1') = SPDMON TRIMEST CATAGE RACE IRMARIT INCOME SNRLGIMP RSKMJOCC RSKMJREG CIGYR
CIGMON DNICNSP ANXDYR ANXDLIF DEPRSLIF DEPRSYR SPDYR  MI_CAT_U
                                          SPDMON_CATAGE SPDMON_IRMARIT SPDMON_ANXDYR SPDMON_DEPRSYR
SPDMON_MICATU SPDMON_RSKMJOCC SPDMON_RSKMJREG SPDMON_INCOME;
      where 1<=RSKMJREG<=3;
```

```
      contrast 'SPDMON' SPDMON 1 SPDMON_CATAGE 1 SPDMON_IRMARIT 1 SPDMON_ANXDYR 1 SPDMON_DEPRSYR 1
SPDMON_MICATU 1 SPDMON_RSKMJOCC 1 SPDMON_RSKMJREG 1 SPDMON_INCOME 1;
run;


*********************************************************************
*              S I G N I F I C A N C E    T E S T I N G            *
*********************************************************************;

*Post-Collinearity assessment;

***************************************************
* Method 1: Eliminate all variables with p>0.05 *
***************************************************;

*model with 1 interaction;
proc surveylogistic data=nsduh2014;
      stratum vestr;
      cluster verep;
      weight analwt_c;
      class TRIMEST (ref='1') CATAGE (ref='2') RACE (ref='1') INCOME (ref='1') SNRLGIMP(ref='1')RSKMJREG
(ref='1') / param=ref order=internal;
      model mrjmon (event='1') = SPDMON TRIMEST CATAGE RACE SNRLGIMP RSKMJREG CIGYR CIGMON DNICNSP ANXDYR
DEPRSLIF DEPRSYR
                                              SPDMON_DEPRSYR;
      where 1<=RSKMJREG<=3;
      ods output surveylogistic.covb=covfile;
run;
*SPDMON_DEPRSYR 0.9338;


*drop SPDMON_DEPRSYR;
proc surveylogistic data=nsduh2014;
      stratum vestr;
      cluster verep;
      weight analwt_c;
      class TRIMEST (ref='1') CATAGE (ref='2') RACE (ref='1') INCOME (ref='1') SNRLGIMP(ref='1')RSKMJREG
(ref='1') / param=ref order=internal;
      model mrjmon (event='1') = SPDMON TRIMEST CATAGE RACE SNRLGIMP RSKMJREG CIGYR CIGMON DNICNSP ANXDYR
DEPRSLIF DEPRSYR;
      where 1<=RSKMJREG<=3;
      ods output surveylogistic.covb=covfile;
```

```
run;
*DEPRSLIF 0.8896 ;

*drop DEPRSLIF;
proc surveylogistic data=nsduh2014;
      stratum vestr;
      cluster verep;
      weight analwt_c;
      class TRIMEST (ref='1') CATAGE (ref='2') RACE (ref='1') INCOME (ref='1')SNRLGIMP(ref='1') RSKMJREG
(ref='1')/ param=ref order=internal;
      model mrjmon (event='1') = SPDMON TRIMEST CATAGE RACE SNRLGIMP RSKMJREG CIGYR CIGMON DNICNSP ANXDYR
ANXDLIF DEPRSYR;
      where 1<=RSKMJREG<=3;
run;
*RACE 0.7549;

*drop RACE;
proc surveylogistic data=nsduh2014;
      stratum vestr;
      cluster verep;
      weight analwt_c;
      class TRIMEST (ref='1') CATAGE (ref='2') INCOME (ref='1')SNRLGIMP(ref='1') RSKMJREG (ref='1')/
param=ref order=internal;
      model mrjmon (event='1') = SPDMON TRIMEST CATAGE SNRLGIMP RSKMJREG CIGYR CIGMON DNICNSP ANXDYR
ANXDLIF DEPRSYR;
      where 1<=RSKMJREG<=3;
run;
*CIGYR 0.4481;

*drop CIGYR;
proc surveylogistic data=nsduh2014;
      stratum vestr;
      cluster verep;
      weight analwt_c;
      class TRIMEST (ref='1') CATAGE (ref='2') INCOME (ref='1')SNRLGIMP(ref='1') RSKMJREG (ref='1')/
param=ref order=internal;
      model mrjmon (event='1') = SPDMON TRIMEST CATAGE SNRLGIMP RSKMJREG CIGMON DNICNSP ANXDYR ANXDLIF
DEPRSYR;
      where 1<=RSKMJREG<=3;
run;
*DNICNSP 0.2506;
```

```
*drop DNICNSP;
proc surveylogistic data=nsduh2014;
      stratum vestr;
      cluster verep;
      weight analwt_c;
      class TRIMEST (ref='1') CATAGE (ref='2') INCOME (ref='1')SNRLGIMP(ref='1') RSKMJREG (ref='1') /
param=ref order=internal;
      model mrjmon (event='1') = SPDMON TRIMEST CATAGE SNRLGIMP RSKMJREG CIGMON ANXDYR ANXDLIF DEPRSYR;
      where 1<=RSKMJREG<=3;
run;
*SNRLGIMP 0.1830;

*drop SNRLGIMP;
proc surveylogistic data=nsduh2014;
      stratum vestr;
      cluster verep;
      weight analwt_c;
      class TRIMEST (ref='1') CATAGE (ref='2') INCOME (ref='1') RSKMJREG (ref='1')/ param=ref
order=internal;
      model mrjmon (event='1') = SPDMON TRIMEST CATAGE RSKMJREG CIGMON ANXDYR ANXDLIF DEPRSYR;
      where 1<=RSKMJREG<=3;
run;
*ANXDYR 0.2019;

*drop ANXDYR;
proc surveylogistic data=nsduh2014;
      stratum vestr;
      cluster verep;
      weight analwt_c;
      class TRIMEST (ref='1') CATAGE (ref='2') INCOME (ref='1') RSKMJREG (ref='1') / param=ref
order=internal;
      model mrjmon (event='1') = SPDMON TRIMEST CATAGE RSKMJREG CIGMON ANXDLIF DEPRSYR;
      where 1<=RSKMJREG<=3;
run;
*ANXDLIF 0.1958;

*drop ANXDLIF;
proc surveylogistic data=nsduh2014;
      stratum vestr;
      cluster verep;
```

```
        weight analwt_c;
        class TRIMEST (ref='1') CATAGE (ref='2') INCOME (ref='1') RSKMJREG (ref='1') / param=ref
order=internal;
        model mrjmon (event='1') = SPDMON TRIMEST CATAGE RSKMJREG CIGMON DEPRSYR;
        where 1<=RSKMJREG<=3;
run;
*DEPRSYR 0.1507;

*drop DEPRSYR;
proc surveylogistic data=nsduh2014;
        stratum vestr;
        cluster verep;
        weight analwt_c;
        class TRIMEST (ref='1') CATAGE (ref='2') INCOME (ref='1') RSKMJREG (ref='1') / param=ref
order=internal;
        model mrjmon (event='1') = SPDMON TRIMEST CATAGE RSKMJREG CIGMON;
        where 1<=RSKMJREG<=3;
run;
*RSKMJREG 0.1019;

*drop RSKMJREG;
proc surveylogistic data=nsduh2014;
        stratum vestr;
        cluster verep;
        weight analwt_c;
        class TRIMEST (ref='1') CATAGE (ref='2') INCOME (ref='1')/ param=ref order=internal;
        model mrjmon (event='1') = SPDMON TRIMEST CATAGE CIGMON;
run;
*all variables <0.05;


*************************************************************************
* Method 2: Establish Correlates of Primary Interest and then Eliminate all variables with p>0.05
*************************************************************************;

*Variables of interst = TRIMEST CATAGE RSKMJREG CIGMON DEPRSYR;

*Resulting model;
proc surveylogistic data=nsduh2014;
        stratum vestr;
        cluster verep;
```

```
      weight analwt_c;
      class TRIMEST (ref='1') CATAGE (ref='2') INCOME (ref='1') RSKMJREG (ref='1') / param=ref
order=internal;
      model mrjmon (event='1') = SPDMON TRIMEST CATAGE RSKMJREG CIGMON DEPRSYR;
      where 1<=RSKMJREG<=3;
run;
*pulled from Method 1 before RSKMJREG AND DEPRSYR are dropped;


**********************************
*     C O N F O U N D I N G      *
**********************************;

*GOLD STANDARD;
proc surveylogistic data=nsduh2014;
      stratum vestr;
      cluster verep;
      weight analwt_c;
      class TRIMEST (ref='1') CATAGE (ref='2') RSKMJREG (ref='1') / param=ref order=internal;
      model mrjmon (event='1') = SPDMON TRIMEST CATAGE RSKMJREG CIGMON DEPRSYR;
      where 1<=RSKMJREG<=3;
run;

*drop TRIMEST;
proc surveylogistic data=nsduh2014;
      stratum vestr;
      cluster verep;
      weight analwt_c;
      class CATAGE (ref='2') RSKMJREG (ref='1') / param=ref order=internal;
      model mrjmon (event='1') = SPDMON CATAGE RSKMJREG CIGMON DEPRSYR;
      where 1<=RSKMJREG<=3;
run;

*drop CATAGE;
proc surveylogistic data=nsduh2014;
      stratum vestr;
      cluster verep;
      weight analwt_c;
      class TRIMEST (ref='1') RSKMJREG (ref='1') / param=ref order=internal;
      model mrjmon (event='1') = SPDMON TRIMEST  RSKMJREG CIGMON DEPRSYR;
      where 1<=RSKMJREG<=3;
```

```
run;

*drop RSKMJREG;
proc surveylogistic data=nsduh2014;
      stratum vestr;
      cluster verep;
      weight analwt_c;
      class TRIMEST (ref='1') CATAGE (ref='2') / param=ref order=internal;
      model mrjmon (event='1') = SPDMON TRIMEST CATAGE CIGMON DEPRSYR;
run;

*drop CIGMON;
proc surveylogistic data=nsduh2014;
      stratum vestr;
      cluster verep;
      weight analwt_c;
      class TRIMEST (ref='1') CATAGE (ref='2') RSKMJREG (ref='1') / param=ref order=internal;
      model mrjmon (event='1') = SPDMON TRIMEST CATAGE RSKMJREG DEPRSYR;
      where 1<=RSKMJREG<=3;
run;

*drop DEPRSYR;
proc surveylogistic data=nsduh2014;
      stratum vestr;
      cluster verep;
      weight analwt_c;
      class TRIMEST (ref='1') CATAGE (ref='2') RSKMJREG (ref='1') / param=ref order=internal;
      model mrjmon (event='1') = SPDMON TRIMEST CATAGE RSKMJREG CIGMON;
      where 1<=RSKMJREG<=3;
run;

*drop TRIMEST & CATAGE;
proc surveylogistic data=nsduh2014;
      stratum vestr;
      cluster verep;
      weight analwt_c;
      class  RSKMJREG (ref='1') / param=ref order=internal;
      model mrjmon (event='1') = SPDMON RSKMJREG CIGMON DEPRSYR;
      where 1<=RSKMJREG<=3;
run;
```

```
*CONFOUNDING RESULTS: dropping any variable results in greater than 10% change in estimate;


*using new RSKMJ variable;
**********************************************************************
* F I N A L   M O D E L:

*GOLD STANDARD;
proc surveylogistic data=nsduh2014;
      stratum vestr;
      cluster verep;
      weight analwt_c;
      class TRIMEST (ref='1') CATAGE (ref='2') RSKMJ (ref='1') / param=ref order=internal;
      model mrjmon (event='1') = SPDMON TRIMEST CATAGE RSKMJ CIGMON DEPRSYR;
run;

**********************************************************************
```