

Exploring the Association between Marijuana Use, Depression, and Suicidal Ideation

by

Najwa Mardini

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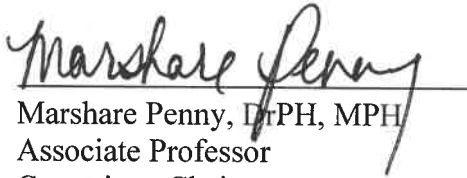
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Najwa Mardini

has met the thesis requirements  
for the degree of  
Master of Public Health

Approved by:

  
Marshare Penny, DrPH, MPH  
Associate Professor  
Committee Chair

  
Ashley V. Parks, DrPH, MPH  
Assistant Professor  
Committee Member

## **Abstract**

The normalization of marijuana and the national increase of its use have been identified as public health issues (Lau et al., 2015; Tilburg, Hodge, & Gourdet, 2019). In addition, depression and mental health in the United States have become an increasingly important issue to address. Current research has indicated a need for further exploration regarding the use of marijuana and the potential mental health issues that could arise from it (Stoner, 2017). The purpose of this study was to explore the association between marijuana use and a major depressive episode (MDE). Additionally, this study explored the potential link between marijuana use and suicidal ideation. Data for this study was obtained from the 2017 National Survey on Drug Use and Health (NSDUH), and participants were U.S. adults ages 18 and older. A cross-sectional study design was used, and a random sample of 108 participants was selected. The results of this study indicated that there was no significant association between marijuana use and experiencing an MDE ( $X^2(1) = .037, p = .847$ ), and no association between marijuana use and suicidal ideation ( $X^2(1) = 5.15, p = .174$ ). Additionally, alcohol use, cocaine use, ethnicity, gender, heroin use, methamphetamine use, and school attendance had no effect and did not modify the relationship between marijuana use and experiencing an MDE ( $X^2(13) = 12.386, p = .496$ ).

*Key Words: Marijuana, Depression, Suicidal Ideation, Logistic Regression, NSDUH*

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## **Review of Literature**

### **Marijuana Use in the U.S.**

In the last two decades, marijuana has been an increasingly popular topic for legislators, public health professionals, and concerned citizens. Researchers have conducted studies and evaluated pilot projects to understand how legalizing marijuana would affect its use and more specifically, if there is any medicinal value to the drug. The Substance Abuse and Mental Health Services Administration ([SAMHSA] 2018) named it the most frequently used illicit drug in the United States.

Another reason marijuana has been a controversial topic may be due to the number of states that have legalized adult recreational use of marijuana: Colorado and Washington officially legalized recreational marijuana in 2012; Alaska, Oregon, and the District of Columbia followed shortly after in 2014; and California, Nevada, Massachusetts, and Maine legalized it in 2016 (Hanson & Garcia, 2018). Michigan and Vermont both followed suit, making them the 10<sup>th</sup> and 11<sup>th</sup> states to legalize adult recreational marijuana use (Hanson & Garcia, 2018). In 2007, the National Institute on Drug Abuse (2015) reported that 14.5 million Americans used marijuana; that number climbed to 19.8 million in 2013. Currently there are approximately, 22.2 million marijuana users in the United States (Centers for Disease Control [CDC], 2018). However, these numbers are questionable because marijuana use remains a taboo topic so many users will not admit to it, making marijuana use likely to be underreported. Further, marijuana use is reported to be highest among those of late adolescence and early adulthood. This is significant because, during this

developmental period, one has the highest risk of developing depressive and anxiety symptoms (Grunberg, Cordova, Bidwell, & Ito, 2015).

As marijuana use has become increasingly popular, new forms of use and strains of the drug are being marketed (Troup, Andrzejewski, Braunwalder, & Torrence, 2016). Depending on a consumer's preference, one might smoke marijuana in a concentrated form referred to as marijuana wax, eat it in a form such as a brownie or candy referred to as an edible, or apply it on one's skin in a topical oil (Troup et al., 2016). Instead of the traditional ways to use marijuana, such as smoking it through a wrapped blunt or using other marijuana accessories such as a pipe, more marijuana users are consuming marijuana edibles. Edibles have tetrahydrocannabinol (THC), which is the psychoactive ingredient in marijuana (Cavazos-Rehg, Zewdie, Krauss, & Sowles, 2018). A recently published consumer survey panel found that 16% of adult and 40% of high school senior marijuana users consume marijuana in the form of edibles (Cavazos-Rehg et al., 2018). This has raised concerns for medical and public health professionals since the Food and Drug Administration (FDA) does not regulate the potency and ingredients in edibles. High THC potency can cause grave consequences such as psychosis, anxiety, or an induced state of panic (Cavazos-Rehg et al., 2018).

### **Trends in Attitudes Towards Marijuana Use**

Since the legalization of recreational marijuana use, attitudes have shifted towards acceptance and viewing the drug as harmless (Hasin, 2017). In general, marijuana use for recreational and medicinal purposes has become increasingly popular and has become accepted in most states, which has been demonstrated

through legislative actions, public opinion polls, and ballot measures (Bridgeman & Abazia, 2017). In a 2016 Gallup poll, Americans were surveyed about their views on legalizing marijuana, and 60% of the survey population agreed that the substance should be legalized (Bridgeman & Abazia, 2017).

A study that analyzed status updates on the Twitter social media platform found that young adults follow popular accounts on Twitter that promote the use of marijuana, specifically marijuana edibles (Cavazos-Rehg et al., 2018). The study collected data from 5,000 Twitter users who quoted marijuana use, specifically those who quoted marijuana consumption in an edible form (Cavazos-Rehg et al., 2018). The researchers found that marijuana edibles appear popular among young adults and their consumption is becoming increasingly normalized at a younger adult age (Cavazos-Rehg et al., 2018).

In a qualitative study conducted by Giombi and colleagues (2018), multiple reasons were noted to explain why marijuana users prefer consuming marijuana in an edible form rather than through the traditional method of smoking. Reasons included that edibles do not smell, there is no secondhand smoke, it is more convenient, it is discreet, it produces a longer lasting and less intense high, and it aids in relaxation more than smoking (Giombi et al., 2018). It is important to note that participants within this study also mentioned their dislikes about their consumption of edibles, including how edibles can produce an unpredictable high since they are not regulated. It is difficult to know the exact THC potency levels in each edible product; edibles have delayed effects in which users feel the high after a couple of hours depending on their metabolism (Giombi et al., 2018). Edible consumption is particularly popular in

the states where recreational marijuana is legalized as opposed to those where it is only legalized for medicinal use (Giombi et al., 2018).

### **Trends in Medicinal Marijuana Use**

A total of 33 states, including the U.S. territories of Guam and Puerto Rico, have approved and adopted public medical marijuana programs (Hanson & Garcia, 2018). The comprehensive medical marijuana programs in these 33 states specifically describe which ailments can be treated with medicinal marijuana, the dosage, and the forms in which the patient is allowed to ingest or smoke it (Hanson & Garcia, 2018). Some examples of ailments approved under these medical marijuana programs are epilepsy, multiple sclerosis, cancer, Crohn's disease, mitochondrial disease, Parkinson's, fibromyalgia, sickle cell disease, and most chronic pain conditions (Hanson & Garcia, 2018).

It is important to note that each state has different regulations within their respective medical marijuana programs (Hanson & Garcia, 2018). Currently, the attitudes and trends surrounding medicinal marijuana use are in a constant state of change. The FDA closely monitors public data regarding the use of medicinal marijuana (Bridgeman & Abazia, 2017). Bridgeman and Abazia (2017) argued that if the FDA were to establish a regulatory system in which all sales of recreational and medicinal marijuana were monitored for quality, dosage, and safety, there would be an additional positive shift in attitudes and acceptance as it may give consumers peace of mind about marijuana.

Although 33 states have legalized medical marijuana use and 11 legalized recreational marijuana use, it is important to note that the cultivation, sale, and use of

marijuana in the U.S. is still considered a federal offense which can affect those who are marijuana users for medicinal purposes in the states that have not legalized medicinal marijuana use (Hanson & Garcia, 2018). This can negatively affect those who travel across states and have a chronic illness that necessitates the use of medicinal marijuana to alleviate their pain. If one were to get caught while in the possession of marijuana or use marijuana without a legal permit, it could result in consequences such as a misdemeanor, jail time, or a fine, depending on where the offense took place (Wolfe, 2018). Societal implications of legalized medicinal marijuana use include, but are not limited to, motor vehicle crashes and driving under the influence of marijuana, increased marijuana related emergency room visits, psychiatric morbidity such as depression and anxiety, and unintentional prenatal exposure (Hasin, 2017). These are some of the consequences that are directly associated with normalizing marijuana use in the U.S. (Hasin, 2017).

A longitudinal study conducted in Norway yielded findings that indicated that exposure to marijuana by itself was not necessarily linked to depression but using marijuana more than 11 times in the last year could be associated with suicidal ideation (Pederson, 2008). Furthermore, another study conducted examined prenatal marijuana exposure and the possibility of future depressive symptoms in children 10 years later (Gray, Day, Leech, & Richardson, 2005). The children of women who were exposed to marijuana in their second and third trimesters were more likely to experience depressive symptoms at age 10. Marijuana exposure during that time in the pregnancy was a significant predictor in the children's depressive symptoms (Gray et al., 2005).

In another study, white matter in the brain and marijuana use were examined together; the results indicated that both marijuana use and white matter interacted together to predict depressive symptoms in those of adolescent age (Medina, Nagel, Park, McQueeney, & Tapert, 2007). Essentially, this study implied that although a direct link between marijuana use and depression is not confirmed, marijuana use may affect white matter volume in the brain which may negatively affect one's mood, causing depressive symptoms (Medina et al., 2007). There has also been a shift in physicians' attitudes towards the acceptance of marijuana use as a means to alleviate the symptoms of terminal illness such as cancer and Alzheimer's disease. Physicians, neurologists, and nurses have recommended the use of edibles for those who are terminally ill to combat painful symptoms of these terminal illnesses.

### **Depression in the U.S.**

Depression is a condition in which one has frequent changes in mood, frequently experiences feelings of helplessness and sadness, and struggles with performing normal daily activities because of these symptoms (Brody, Pratt, & Hughes, 2018). Major depression is diagnosed when these symptoms continue for more than two weeks (Brody et al., 2018). The National Center for Health Statistics (NCHS) reported that between 2013-2016, 8.1% of adults aged 20 years and older had depression that lasted for at least two weeks (Brody et al., 2018). The NCHS depression prevalence rate is based on scores from the Patient Health Questionnaire (PHQ-9), which is used in a wide range of medical facilities as a depression screening tool to help diagnose patients with depression (Brody et al., 2018).

According to the National Institute of Mental Health ([NIMH] 2017), one of the most common mental disorders in the U.S. is major depression. Approximately 16.2 million Americans aged 18 years and older have experienced at least one major depressive episode (MDE) in their life (NIMH, 2017). This number is representative of 6.7% of adults in the U.S. (NIMH, 2017). MDE's were reported to be highest for adults aged 18-25 years; this is important to note because those years are known to be a transitional time from young to middle-aged adulthood (NIMH, 2017).

The Blue Cross Blue Shield insurance company collected data on the varying rates of depression across the United States. Their study revealed that patients diagnosed with depression who have sought treatment across the nation is increasing (Welch, 2018). The study gathered data from their insured patients during 2013 to 2016 and revealed that there is a yearly increase in most states in respective depression prevalence rates (Welch, 2018). In the study, most statewide depression rates ranged from 2%-6% of the population (Welch, 2018). One crucial finding of this data revealed that only 15% of those insured patients were diagnosed with depression only; the rest of the insured population who was diagnosed with major depression had other conditions in addition to their depression diagnosis (Blue Cross Blue Shield, 2018).

As shown in Table 5 and Figure 1, the differences for the depression rates within certain states is widely unknown and can be blamed on multiple reasons (see Appendix C and D). One of the reasons is that women are twice as likely to be diagnosed with depression than men (Blue Cross Blue Shield, 2018). The next reason is that the Millennial Generation has had the highest rates of depression when



compared to their Generation X counterparts (Welch, 2018). Another reason that could explain the increased depression rates is that the states that had the highest rates of depression are also known for their cold temperatures and harsh winters, which subject individuals to resort to other ways to stay entertained such as increased screen time and possibly illicit drug use along with increased isolation (Welch, 2018).

### **Depression and Marijuana Use**

One of the outcomes of using marijuana is mood disorders such as anxiety and post-traumatic stress disorder (Hasin, 2017). Research among college students found that there is a significant relationship between casual cannabis use and receiving a high score for depressive symptoms on the Epidemiological Studies Depression Scale (Troup et al., 2016). Clinical studies reported increased rates of depression among patients who receive treatment for their marijuana dependence. Marijuana dependence rates and use are increased among those who seek treatment for their depressive symptoms (Lynskey, 2004).

In a study by Van, Van, Monshouwer, and de Graaf (2007), there was a significant association between marijuana use and depressive symptomology. In the same study, cannabis use and the onset of depression and bipolar disorder were significantly associated even after adjusting for confounders (Van et al., 2007). Research by Fritz (2016) found a significant relationship between marijuana use and early adulthood depression but explained that it could primarily be due to shared environmental influences. For example, factors such as early childhood adversity might lead one to seek relief in using marijuana, but that same factor might also lead someone to develop symptoms of depression. Another study concluded that a modest

association exists between heavy cannabis use and depression (Degenhardt, Hall, & Lynskey, 2003). However, little to no evidence was found connecting marijuana use post-depression diagnosis, leaving the hypothesis that depressed individuals self-medicate with marijuana weak and unsupported (Degenhardt et al., 2003).

In another cohort longitudinal study, results indicated an association between heavy marijuana use and developing depression (Manrique-Garcia, Zammit, Dalman, Hemmingsson, & Allebeck, 2012). However, after controlling for confounding factors, such as having experienced a troubled childhood and frequent alcohol consumption, that association disappeared (Manrique-Garcia et al., 2012). In most of the studies where confounding factors were taken into account, the association between marijuana use and the development of depression disappeared (Stoner, 2017). A study conducted by Green and Ritter (2000) found that participants who used marijuana to cope with problems were more depressed than those who did not use marijuana to cope with their problems. They further concluded that there was no significant association between marijuana use and the development of depressive symptoms in adulthood (Green & Ritter, 2000). Temperament and individual behavioral factors explained the inconsistent findings in some of the studies (Stoner, 2017). In a number of studies, an increase in depressive symptoms was explained by alcohol and tobacco use rather than marijuana use (Green & Ritter, 2000).

Research on the relationship between marijuana use and depression has demonstrated a high prevalence rate of depression among marijuana users and also demonstrated that depressed individuals use marijuana to alleviate the symptoms (Bahorik et al., 2018). Recreational and non-medical marijuana users are at-risk for

developing psychiatric symptoms that can severely reduce quality of life and place them at a greater risk for chronic illness and a slew of other mental and physical ailments (Bahorik et al., 2018). Studies that explored possible associations between marijuana use and depression in the past yielded significant associations, inconclusive results, and no associations at all. However, the majority of the available literature have concluded that there needs to be more research done in this area. One important point to note is that most studies have not differentiated between the short and long-term use effects of marijuana (Gage et al., 2015).

The two most common methods of treatment for depression are psychotherapy also referred to as mental health counseling, psychotropic medications, or a combination of both (Olfson et al., 2002). Americans who use marijuana at an early age may self-medicate and continue to treat their depressive symptoms with marijuana (Green & Ritter, 2000). However other studies have minimized or weakened the hypothesis that many people to self-medicate after experiencing depressive symptoms (Degenhardt et al., 2003). In most of the studies where confounding factors were taken into account, the association between marijuana use and the development of depression disappeared (Stoner, 2017). The gap in the literature is that most of the literature linking marijuana use and depression is inconclusive because some of it confirms an association and some of it rejects the association between marijuana use and depression. Additionally, previous studies focused on specific populations, such as military personnel, college students, pregnant women, and high school youth, rather than the general U.S. population ages 18 and older.

## **Suicidal Ideation**

Suicidal ideation is a predictor of suicidal behavior, and suicidal behavior is one of the leading causes of death and disability worldwide (Klonsky, May, & Saffer, 2016). Experiencing depression, feelings of hopelessness, and having other mental disorders have been significant predictors of suicidal behavior (Klonsky et al., 2016). However, it is crucial to note that although these factors have been established to be strong predictors of suicidal ideation, there still is not a definitive understanding about what exactly triggers one to carry out the actual plan of committing suicide; further research would need to be conducted to understand those triggers (Klonsky et al., 2016). The definition of suicidal ideation is when one thinks about, considers, or plans to take their own life (NIMH, 2016). Approximately 9.8 million adults in the United States in 2016 considered taking their own life, 1.3 million adults attempted suicide, and 2.8 million adults made a suicide plan (NIMH, 2016). Since many studies have been conducted linking marijuana use and depression, a next step in the research is to explore a potential link between marijuana use and suicidal ideation.

One longitudinal study that examined the link between cannabis use and suicide yielded results that showed a strong association between them; after adjusting for confounding factors, this association was eliminated (Price, Hemmingsson, Lewis, Zammit, & Allebeck, 2018). However, not enough literature exists to explain or establish a link between marijuana use and suicidal ideation. A study that assessed the link between marijuana use and different measures of psychosocial outcomes, such as depression, suicide, suicidal ideation, crime and other drug use, found that there was a strong association between heavy or regular marijuana use and crime, depression,

suicidal ideation, and other drug use (Fergusson, Horwood, & Swain-Campbell, 2002). This study also found a stronger association between regular marijuana use in those adolescents aged 14-15 years of age as opposed to their 20-21-year-old counterparts, which indicates that the younger one is, the more one is affected by marijuana use (Fergusson et al., 2002).

Another study that examined the link between marijuana dependence, major depressive disorder, suicidal ideation, and suicide attempts found that there is an association between marijuana dependence and suicidal ideation, and this association could not be explained by genetic predisposing factors (Lynskey, 2004). Other findings that linked early onset marijuana use in youth and a later diagnosis of major depressive disorder are likely reflected by common predisposing genetic and environmental factors (Lynskey, 2004). However, one cannot rule out the possibility that early marijuana use is a predisposition to suicidal ideations and behavior (Lynskey, 2004). Updated research regarding the association between marijuana use and suicidal ideation is needed because of the recent legalization of recreational marijuana in 11 states and increased normalization of its use in addition to the rising depression rates in the United States. Recent data can reveal new information on suicidal ideation risk factors and if the normalization trend of using marijuana is potentially affecting suicidal ideation in adults.

### **Purpose of the Study**

The purpose of this study was to explore the association between marijuana use and depression. Additionally, this study explored the potential link between marijuana use and suicidal ideation.

## **Research Questions**

The following questions drove this study:

1. Is there a significant association between marijuana use and depression among adults?
2. Does marijuana use, alcohol use, heroin use, cocaine use, methamphetamine use, race/ethnicity, gender and school attendance predict depression?
3. Is marijuana use associated with suicidal ideation?

## **Hypothesis**

For the first research question, it is hypothesized that there is a significant association between marijuana use and depression among adults. For the second research question, it is hypothesized that marijuana use, alcohol use, heroin use, cocaine use, methamphetamine use, race/ethnicity, gender, and school attendance predict depression. For the third research question, it is conjectured that, due to the link between marijuana use and depression and established associations between depression and suicidal ideations, there is a significant association between marijuana use and suicidal ideation.

## **Method**

### **Design**

This study uses a cross-sectional design and data from the National Survey on Drug Use and Health (NSDUH), which was collected by the Substance Abuse and Mental Health Services Administration (SAMHSA). The NSDUH dataset for the year 2017 was used in the analyses. The 2017 NSDUH dataset included 68,032 data entries; however, that number only applies to the restricted use data file. The amount of completed entries in the public use dataset is 56,276. The public use file is the dataset that was used for this study.

### **Procedures**

The SAMHSA is an organization within the United States Department of Health and Human Services. It is responsible for collecting the data for NSDUH. RTI International, a non-profit organization associated with the University of North Carolina, North Carolina State University, and Duke University, has conducted the NSDUH since 1988 (NSDUH, 2018). All participant data is de-identified.

Data is collected quarterly, and each data collection period lasts three months. A random sample of U.S. households are chosen to participate in the NSDUH. Once they are selected, a designated RTI employee will conduct in-person interviews with individuals in each household (NSDUH, 2018). Once a participant within the household is selected, based on a few initial general questions by the interviewer, no one else in the household can be substituted in that person's place in the survey (NSDUH, 2018).

It is important to note that although the RTI interviewer starts the process by asking a few initial general questions; there is a chance that no one in the household will be selected for the survey (NSDUH, 2018). In cases where the respondent is an active duty military member or under the age of 18, he or she cannot be selected for the interview. In cases when someone is 18 years of age or older, he or she can be interviewed and can also sign an informed consent form on the behalf of a child or someone he or she can claim as a dependent under the age of 18.

Those selected for the survey receive 30 dollars in cash upon completion of their interview (NSDUH, 2018). After an individual is selected as a participant for the survey, the questions are administered on a laptop computer that the RTI interviewer provides; no previous computer skills are required for one to be eligible to accurately answer the questions (NSDUH, 2018). Lastly, to ensure confidentiality, each NSDUH participant is assigned a unique code number, and the interviewer is not aware of the participants' answers or unique code identification number (NSDUH, 2018).

### **Participants**

The participants in this study are ages 18 and older and have been asked questions about whether or not they have ever used marijuana, whether or not they have depressive symptoms, and if they have ever experienced suicidal ideation. Using G\*Power Software Version 3.1.9.2, a moderate effect size, an alpha level of .05, and a power of 80%, the estimated minimum sample size required to perform all analyses was 108. To ensure that the study will not yield a Type 1 error, a random sample of 108 entries was extracted from the original dataset. This was performed three times to



ensure that all of the frequencies and descriptive analysis were the same and to ensure representativeness of the sample.

### **Independent Variable and Dependent Variable**

There is one independent variable in this research study. The independent variable in this study is marijuana use measured by the question, *“Have you ever, even once, used marijuana or hashish?”* with a possible response options of “Yes” or “No.”

There are two dependent variables in this study. The first dependent variable is major depression episode (MDE) and whether a participant has experienced an MDE in his or her lifetime. An MDE is measured by a depressive symptom questionnaire comprised of nine questions with a possible answer of “Yes” or “No” (see Appendix E). If a participant answers “Yes” to five out of the nine questions, then he or she is considered to have experienced an MDE at some point during his or her lifetime and will be coded as “Yes.” All other responses will be coded as “No.” The second dependent variable is suicidal ideation, measured by the question, *“Did you think about committing suicide?”*, with a possible response of “Yes” or “No.”

### **Variables in Regression Model**

According to the literature, there were some variables to be considered that could affect the MDE dependent variable (Troup et al., 2016; Manrique-Garcia et al., 2012; Harder, Morral, & Arkes, 2006). Variables measuring the history of substance abuse, such as heroin, cocaine, methamphetamine, and alcohol, were accounted for in the regression model. Other social and socioeconomic variables such as ethnicity, gender, and school attendance were also accounted for in the model.

There was a total of nine variables in the regression model; in addition to the depression variable, there were eight other variables in the model. The variables were measured as follows. The participants were asked if they had, “*Ever used marijuana/hashish?*”, with a possible answer of “Yes,” “No,” “Don’t know,” or “Refused.” The participants were asked if they had, “*Ever had a drink of alcoholic beverage?*”, with a possible answer of “Yes,” “No,” “Don’t know,” or “Refused.” The participants were asked if they had, “*Ever used cocaine?*”, with a possible answer of “Yes,” “No,” “Don’t know,” or “Refused.” The participants were asked if they had, “*Ever used heroin?*”, with a possible answer of “Yes,” “No,” “Don’t know,” or “Refused.” The participants were asked if they had, “*Ever used methamphetamine?*”, with a possible answer of “Yes,” “No,” “Don’t know,” or “Refused.”

The participants were asked to self-identify their ethnicity/race from one of the following options: Non-Hispanic White, Non-Hispanic Black African American, Non-Hispanic Native American/Alaskan Native, Non-Hispanic Hawaiian/Other Pacific Islander, Non-Hispanic Asian, Non-Hispanic more than one race, or Hispanic. The participants were asked their gender with a possible selection of “Male” or “Female.” The participants were asked if they were attending school at the time of interview with a possible answer of “Yes,” “No,” “Don’t know,” or “Refused.”

### **Data Analysis**

A univariate analysis was performed to summarize demographic characteristics such as sex and race/ethnicity at the time of interview. To answer the first research question, “*Is there a significant association between marijuana use and*

*depression among adults?*”, a Chi-Square Test of Independence was conducted. To answer the second question, *“Is there a predictive relationship between marijuana use, depression, alcohol use, heroin use, cocaine use, ethnicity, gender, methamphetamine use, and school attendance?”*, a binary logistic regression model was used. There are nine variables accounted for in this model: marijuana use, alcohol consumption, heroin use, cocaine use, methamphetamine use, school attendance, gender, race/ethnicity, and major depressive episode. Data analysis was performed using the Statistical Package for the Social Sciences (SPSS), version 24. To answer the third research question, *“Is marijuana use associated with suicidal ideation?”*, a Chi-Square Test of Independence was conducted. Data analysis was performed using the Statistical Package for the Social Sciences (SPSS), version 24.

## Results

### Major Findings

The total sample size in this research study was 108 participants. The majority of participants were female (52.8%), and 57.4% of the sample identified as Non-Hispanic White. Participants who self-reported current school attendance made up 18.3% of the sample, and 81.7% of the sample reported that they were not attending school at the time of the interview. The education levels of the participants ranged from fifth grade to college graduate or higher. More than a quarter (27.8%) completed high school and received either a GED or diploma certificate, while 26.9% had earned some college credits but had not yet earned a degree.

To answer the first research question, *“Is there a significant association between marijuana use and depression among adults?”*, a Chi-square Test of Independence was performed. It was hypothesized that there was an association between marijuana use and having a major depressive episode (MDE). The results of the analysis indicated there was no significant association between marijuana use and having an MDE ( $X^2 (1) = .037, p = .847$ ).

To answer the second research question, *“Is there a predictive relationship between depression and, marijuana use, alcohol use, heroin use, cocaine use, ethnicity, gender, methamphetamine use, and school attendance?”*, a binary logistic regression was performed. It was hypothesized that marijuana use was predictive of depression after accounting for alcohol use, cocaine use, ethnicity, gender, heroin use, methamphetamine use, and school attendance. To test this hypothesis, two regression models were produced. The first model included marijuana use as the exposure

variable and depression as the outcome variable. The second model produced included additional predictor variables to explore changes in the relationship and identify potential confounders. The first model was not found to be significant ( $X^2 (1) = .037, p = .847$ ). The second model was also not found to be significant ( $X^2 (13) = 12.386, p = .496$ ). Both models yielded results that indicated no predictive relationship exists between marijuana use and the outcome of depression.

To answer the third research question is, "*Is marijuana use associated with suicidal ideation?*", a Chi-square Test of Independence was performed. It was hypothesized that an association exists between marijuana use and suicidal ideation. The results of the analysis indicated no significant association between marijuana use and seriously thinking about committing suicide in the past 12 months ( $X^2 (1) = 5.15, p = .174$ ).

## Discussion

### Summary of Major Findings

The purpose of this study was to explore the association between marijuana use and depression in adults ages 18 and older. In addition, this study explored the potential link between marijuana use and suicidal ideation. The first hypothesis for the research study posited a significant association exists between marijuana use and experiencing a major depressive episode (MDE); however, the study findings indicated that no association exists between marijuana use and experiencing an MDE ( $p = .847$ ). These results are inconsistent with a study conducted by Gage and colleagues (2015), which found cannabis use increased the odds that one will develop depression, even though the association was weak (fully adjusted OR 1.30, 95% CI 0.98, 1.72). Alternatively, the results are consistent with two other studies that examined marijuana use and depression in a longitudinal format. The first study yielded results where the association between marijuana use and depression disappeared after adjusting for confounders such as alcohol use, smoking, use of other drugs, and early socioeconomic position (Manrique-Garcia et al., 2012). In the second study, prior to adjusting for group differences, the odds of past marijuana users experiencing depression was 1.4 times higher than the comparison group; however, after adjusting for group differences there was no significant association between past marijuana users and their possibility of developing depression later on in life (Harder et al., 2006).

Many of the studies conducted on this subject resulted in significant associations between marijuana use and major depressive disorder, but when adjusted

for potential confounders, the association ceases to exist. For example, the confounders that are usually adjusted for are the use of drugs other than marijuana; socioeconomic status variables, such as where one lives, financial stability, smoking, or excessive or risky alcohol use; and any disturbing childhood behaviors (Manrique-Garcia et al., 2012). In another study, the confounding variables were race, gender, region of residence, criminal activity, and alcohol use (Harder et al., 2006). The results of the aforementioned studies indicated that the association between marijuana use and depression could be attributed to a combination of external factors that are identified as covariates or confounders in these studies; the initial significant associations seem to be due to not having a consideration for a combination of the external factors that affect outcomes of depression.

With regards to the second research question, *“Is there a predictive relationship between depression and, marijuana use, alcohol use, heroin use, cocaine use, ethnicity, gender, methamphetamine use, and school attendance?”*, it was hypothesized that marijuana use, alcohol use, heroin use, cocaine use, ethnicity, gender, and methamphetamine use predicted participants experiencing an MDE. The findings indicated that there is no association between marijuana use and experiencing an MDE, and furthermore, none of the variables in the model acted as predictors for the outcome of depression. The findings of this study were consistent with Harder et al.’s (2006) findings that, prior to adjusting for group differences, the odds ratio was 1.4 (95% CI: 1.1, 1.9), indicating that the odds of past marijuana users experiencing depression was 1.4 times higher than the comparison group. After adjusting for group differences, the results were (OR 1.1, 95% CI: 0.8, 1.7) (Harder et

al., 2006). These results are inconsistent with Van et al.'s (2007) study, which found that any type of marijuana use resulted in a modest increase in the risk of developing major depression (OR 1.62; 95% CI 1.06-2.48).

One reason that these results may be inconsistent with previous research is that the study by Van and associates (2007) included a 3-year follow-up design that could have affected the results in the same way that this study could be affected by its cross-sectional design. The follow-up design could give inaccurate results because of possible external and internal factors that could have affected the participants. Certain exposures that occurred during this follow-up period, such as the death of a loved one, a heartbreak, loss of employment, lack of financial stability, and many others factors, could have potentially led to the outcome of depression as opposed to marijuana use.

For the third research question, "*Is marijuana use associated with suicidal ideation?*", the findings indicated that there is no association between marijuana use and suicidal ideation. The results are inconsistent with another study that examined cannabis and actual suicide attempts and found a strong association between the two variables; however, the researchers attributed that association to the participants' pre-existing markers of psychological problems rather than the marijuana use (Price et al., 2018). This study's results may not have yielded significant results because no baseline mental health issues or MDE measures were taken prior to running the analysis. There is a possibility that this study could have yielded consistent results to Price et al.'s study if the variables were measured prior to analysis and the variables had a measure of the duration and timeframe of the MDE.



However, this study's results were consistent with a more recent study by Naji and associates (2018). Their findings (OR 1.34, 95% CI: 0.81, 2.22,  $p=0.260$ ) in men and (OR 0.97, 95% CI: 0.61, 1.54,  $p=0.884$ ) in women indicated that there is no association between marijuana use and suicidal behavior with their patient participants (Naji et al., 2018). The study conducted by Naji and associates (2018) has more strength than this one, because the study population used were actual psychiatric patients who had used cannabis and attempted suicide.

### **Public Health Implications**

Increased marijuana use and normalization in society has led to an increase in emergency department visits, unintentional prenatal exposure, and many other effects on society (Hasin, 2017). An increase in informational sessions at workplaces, schools, and community centers by government employees in public health could help reduce the spread of misinformation about marijuana use and its side effects and legal consequences.

Although recreational use of marijuana has been made legal in 11 states, it is still grounds on which someone can be terminated by their employer (Hanson & Garcia, 2018). In addition to informational sessions, there should be more funding set aside to research the effects of marijuana use and the different forms in which it is consumed, such as edibles and wax. Furthermore, there should be a policy that would implement a system that accounts for all marijuana sales, medicinal and recreational. This would be challenging because in order for it to be effective and accurate it would need to be national database that is constantly updated.

In addition, because there is concern over substance abuse when it comes to marijuana and using it in the workplace, around children, etc., there should be a way to account for dispensaries' clients. While this would be difficult and a violation of the Health Insurance Portability and Accountability Act of 1996 (HIPAA), seeing a client's or customer's mental health history or substance abuse history would limit his or her purchases of a certain substance at a time or remove his or her ability to purchase a substance overall. This would make the dispensing of controlled substances with addictive properties safer for these individuals and those around them.

### **Study Limitations**

There are three limitations in this study. The first is that it used a cross-sectional design. Due to the nature of cross-sectional designs, this study only allows one to examine a moment in time. Variables and their frequencies could have been understood if reported over a long period of time, or even if reported at baseline followed-up on for later data collection. This could have a great impact on the accuracy of the results. For example, Harder and associates (2006) conducted a study using a longitudinal design following a cohort of 8,033 participants for 18 years. Their study included baseline measurements, covariates, and the duration and time of marijuana use and depressive symptoms. This made the study yield more accurate results because they accounted for external factors and internal factors that could affect the validity of their findings throughout the process.

The second limitation is that the data was self-reported. Hence, in order to abide by societal standards on a topic that is slowly becoming normalized, marijuana

use may still have been considered taboo by a participant, and therefore some may not have been truthful when submitting their answers. Another reason self-reporting is a limitation is that participants might have forgotten if they have tried marijuana or if they have had an MDE or experienced suicidal ideation. For example, a study conducted by Johnson and Fendrich (2005) found that social desirability and memory retention had a significant effect on measurement error. They examined 627 adults and asked them to self-report their drug use while also taking biological samples of saliva, hair, and urine. They concluded that social desirability and memory both have an impact on the under-reporting and over-reporting of substance abuse (Johnson & Fendrich, 2005).

Lastly, there was no report of timing in regards to when one had been exposed to marijuana. Participants were asked if they had ever used marijuana. Therefore, the exposure could have potentially occurred 10 years prior to having experienced suicidal ideations and an MDE. This again reflects the challenge with cross-sectional studies and their inability to ensure temporality. For future research, it is important to screen participants for pre-existing mental health conditions in order to observe changes in the cohort study and understand causation.

## **Conclusion**

The findings of this study indicate there is no significant association between marijuana use and depression. In addition, there is no association between marijuana use and suicidal ideation. These findings were expected due to the nature of the differences found in the literature and some of the inconclusiveness of the results among the existing research. Further research should be conducted using a

longitudinal cohort approach, and the frequency of the exposure variable, marijuana, should be monitored closely along with the timing and duration of major depressive episodes and suicidal ideation. There is much to discover about marijuana and its influence on different populations, side effects, and implications on society; it is important that further research is conducted on this topic.

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## Appendix A: National Institute of Health Certificate



## Appendix B: IRB Approval

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**RE:** IRB Review

**IRB No.:** 008-1819-EXM

**Project:** The Association Between Marijuana Use and Depression

**Date Complete Application Received:** 8/16/18

**Principle Investigator:** Nwaja Mardini

**Faculty Advisor:** Marshare Penny

**College/Department:** CHS

**IRB Determination:** Exempt Application Approved – Student research using publically available, de-identified secondary data. Data analysis may begin, in accordance with the final submitted documents and approved protocol.

**Future Correspondence:** All future correspondence about this project must include all PIs, Co-PIs, and Faculty Advisors (as relevant) and reference the assigned IRB number.

**Approval Information:** At the completion of the project, you are to submit a Research Closure Form.

**Researcher Responsibilities:** The researcher is responsible for ensuring that the research is conducted in the manner outlined in the IRB application and that all reporting requirements are met. Please refer to this approval and to the IRB handbook for more information.

**Date:** August 21, 2018

## Appendix C: Tables

Table 1

*Demographic Characteristics of 2017 NSDUH Participants (n = 108)*

| Variable  | n  | %    |
|---|----|------|
| Ever Used Marijuana/Hashish                                       |    |      |
| Yes   | 49 | 45.4 |
| No  | 59 | 54.6 |
| Race/Ethnicity  |    |      |
| White   | 62 | 57.4 |
| Black/African American  | 14 | 13.0 |
| Native American/ Alaska Native                                    | 1  | .9   |
| Native Hawaiian/Other Pacific Islander                            | 1  | .9   |
| Asian   | 4  | 3.7  |
| More than one race  | 6  | 5.6  |
| Hispanic  | 20 | 18.5 |
| Gender  |    |      |
| Male  | 51 | 47.2 |
| Female  | 57 | 52.8 |
| Education Level   |    |      |
| 5 <sup>th</sup> Grade or less grade completed                     | 4  | 3.7  |
| 8 <sup>th</sup> Grade Completed                                   | 1  | .9   |
| 9 <sup>th</sup> Grade Completed                                   | 4  | 3.7  |
| 10 <sup>th</sup> Grade Completed                                  | 1  | .9   |
| 11 <sup>th</sup> or 12 <sup>th</sup> Grade Completed (No Diploma) | 7  | 6.5  |
| High School Diploma (GED)   | 30 | 27.8 |
| Some College Credit (No Degree)                                   | 29 | 26.9 |
| Associates Degree   | 11 | 10.2 |
| College Graduate or Higher  | 21 | 19.4 |
| Age Category  |    |      |
| 18-25   | 31 | 28.7 |
| 26-34   | 25 | 23.1 |
| 35-49   | 27 | 25   |
| 50 and Older  | 25 | 23.1 |

Table 2

*Association between Marijuana Use and Major Depressive Episode (MDE)*

|               | Major Depressive Episode (MDE) |             | Adjusted OR (95% CI) |
|---------------|--------------------------------|-------------|----------------------|
|               | Yes<br>N (%)                   | No<br>N (%) |                      |
| Marijuana Use |                                |             |                      |
| Yes           | 9 (47)                         | 40 (45)     | 1.103                |
| No            | 10 (53)                        | 49 (55)     | (.409-2.975)         |

Note: OR, odds ratio; CI, confidence interval. Chi-square test was used to assess the relationship between marijuana use and major depressive episodes.  $p = .847$



Table 3

*Association between Marijuana Use and Suicidal Ideation in the past 12 months*

|               | Suicidal Ideation |             | Adjusted OR (95% CI) |
|---------------|-------------------|-------------|----------------------|
|               | Yes<br>N (%)      | No<br>N (%) |                      |
| Marijuana Use |                   |             |                      |
| Yes           | 4 (80)            | 45 (43.6)   | 5.15                 |
| No            | 1 (20)            | 58 (56.3)   | (.55 – 47.73)        |

Note: OR, odds ratio; CI, confidence interval. Chi-square test was used to assess the relationship between marijuana use and suicidal ideation in the past 12 months.  $p=.174$

Table 4

*Summary of Logistic Regression analysis for variables predicting major depressive episodes*

|         | Predictor                              | B      | SE B      | $\beta$       | CI             |
|---------|--|--------|-----------|---------------|----------------|
| Model 1 | Constant                               | 1.589  | .347      | 4.90          |                |
|         | Marijuana Use                          | -.098  | 0.506     | 0.907         | (.336, 2.448)  |
| Model 2 | Constant                               | 3.458  | 1.341     | 31.756        |                |
|         | Marijuana Use                          | .232   | .655      | 1.261         | (.349, 4.558)  |
|         | Ever Consumed Alcohol                  | -1.449 | 1.206     | .235          | (.022, 2.496)  |
|         | Cocaine Use                            | -.689  | .875      | .502          | (.090, 2.788)  |
|         | Heroin Use                             | 19.603 | 23065.923 | 326041651.635 |                |
|         | Methamphetamine Use                    | -.171  | 1.107     | .843          | (.096, 7.380)  |
|         | Current School Attendance              | .167   | .708      | 1.182         | (.295, 4.732)  |
|         | Gender                                 | -1.133 | .632      | .322          | (.093, 1.111)  |
|         | Race/Ethnicity                         |        |           |               |                |
|         | White*                                 |        |           |               |                |
|         | Black/African American                 | .624   | 1.170     | 1.867         | (.188, 18.514) |
|         | Native American/Alaskan Native         | 19.194 | 40192.969 | 216599643.513 |                |
|         | Native Hawaiian/Other Pacific Islander | 18.961 | 40192.969 | 171721305.708 |                |
|         | Asian                                  | 19.598 | 19083.529 | 324645760.981 |                |
|         | More than one race                     | -.901  | .993      | .406          | (.058, 2.842)  |
|         | Hispanic                               | -.139  | .789      | .870          | (.185, 4.082)  |

Note:  $R^2 = .108$  (Cox-Snell),  $.179$  (Nagelkerke). \*Referent group. \*\* $p < .05$

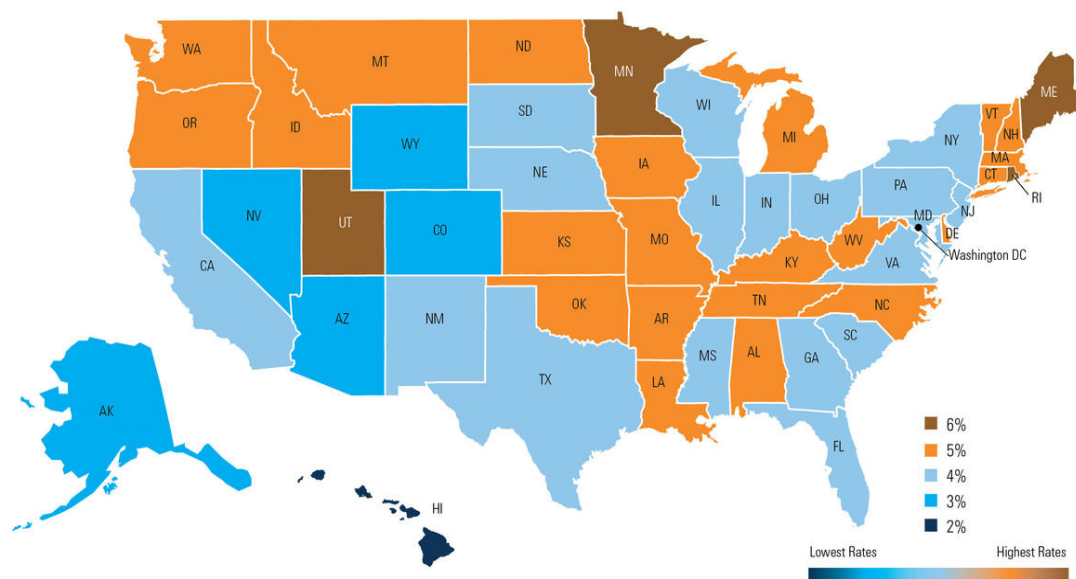
Table 5

*Blue Cross Blue Shield Insurance State Depression Diagnosis Rates*

| 2%     | 3%       | 4%             | 5%             | 6%           |
|--------|----------|----------------|----------------|--------------|
| Hawaii | Alaska   | New Jersey     | Oregon         | Maine        |
|        | Arizona  | New York       | Montana        | Missouri     |
|        | Nevada   | Pennsylvania   | Washington     | Utah         |
|        | Colorado | Maryland       | Idaho          | Rhode Island |
|        | Wyoming  | Virginia       | North Dakota   | Minnesota    |
|        |          | South Carolina | Illinois       |              |
|        |          | Georgia        | Kansas         |              |
|        |          | Florida        | Oklahoma       |              |
|        |          | Mississippi    | Arkansas       |              |
|        |          | Ohio           | Louisiana      |              |
|        |          | Indiana        | Michigan       |              |
|        |          | Wisconsin      | Kentucky       |              |
|        |          | Nebraska       | Tennessee      |              |
|        |          | South Dakota   | Alabama        |              |
|        |          | New Mexico     | North Carolina |              |
|        |          | California     | Connecticut    |              |
|        |          |                | Massachusetts  |              |
|        |          |                | Vermont        |              |
|        |          |                | West Virginia  |              |
|        |          |                | Delaware       |              |

## Appendix D: Blue Cross Blue Shield Depression Study Figure

**EXHIBIT 4: RATES OF MAJOR DEPRESSION DIAGNOSIS BY STATE (2016)**



**Figure 1.** Rates of Major Depressive Diagnosis by 2016 from the Blue Cross Blue Shield of America.

## Appendix E: Major Depressive Episode Measure

### 1. Depressed mood most of the day

1. ... did you feel sad, empty, or depressed **most of the day nearly every day?** (AD24A/ADWRDEPR)
2. ... did you feel discouraged about how things were going in your life **most of the day nearly every day?** (AD24C/ADWRDISC)

A respondent was assigned a positive response to this symptom (D\_MDEA1/AD\_MDEA1=1) if he or she answered yes to either of the above questions.

### 2. Markedly diminished interest or pleasure in all or almost all activities most of the day

1. ... did you lose interest in almost all things like work and hobbies and things you like to do for fun? (AD24E/ADWRLSIN)
2. ... did you lose the ability to take pleasure in having good things happen to you, like winning something or being praised or complimented? (AD24F/ADWRPLSR)

A respondent was assigned a positive response to this symptom (D\_MDEA2/AD\_MDEA2=1) if he or she answered yes to either of the above questions.

### 3. Weight

1. Did you have a much smaller appetite than usual nearly every day during that time? (AD26A/ADWRELES)
2. Did you have a much **larger** appetite than usual nearly every day? (AD26B/ADWREMOR)
3. Did you gain weight without trying to during that [worst/most recent] period of time? (AD26C/ADWRGAIN)
  - i. ... because you were growing? (AD26C1/ADWRGROW)
  - ii. ... because you were pregnant? (AD26C2/ADWRPREG)
4. How many pounds did you gain? (AD26D/ADWRGNL2)
5. Did you **lose** weight without trying to? (AD26E/ADWRLOSE)
  - i. ... because you were sick or on a diet? (AD26E1/ADWRDIET)
6. How many pounds did you lose? (AD26F/ADWRSL2)

A respondent was assigned a positive response to this symptom (D\_MDEA3/AD\_MDEA3=1) if he or she answered yes to questions 'a' or 'b' above, or the

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answer to either question 'd' or 'f' was greater than or equal to 10. (Note that 'd' was only asked if 'ci' and 'cii' were not 'yes,' and 'f' was only asked if 'ei' was not 'yes.')

#### **4. Insomnia or hypersomnia**

1. Did you have a lot more trouble than usual falling asleep, staying asleep, or waking too early nearly every night during that [worst/most recent] period of time? (AD26G/ADWRSLEP)
2. During that [worst/most recent] period of time, did you sleep a lot more than usual nearly every night? (AD26H/ADWRSMOR)

A respondent was assigned a positive response to this symptom (D\_MDEA4/AD\_MDEA4=1) if he or she answered yes to either of the above questions.

#### **5. Psychomotor agitation or retardation**

- a. Did you talk or move more slowly than is normal for you nearly every day? (AD26L/ADWRSLOW)
  - i. (if AD26L=1) Did anyone else notice that you were talking or moving slowly? (AD26M/ADWRSLNO)
- b. Were you so restless or jittery nearly every day that you paced up and down or couldn't sit still? (AD26N/ADWRJITT)
  - i. (if AD26N=1) Did anyone else notice that you were restless? (AD26O/ADWRJINO)

A respondent was assigned a positive response to this symptom (D\_MDEA5/AD\_MDEA5=1) if he or she answered yes to either of the above 'ai' or 'bi' questions. (Note that 'ai' was only asked if 'a' was 'yes' and 'bi' was only asked if 'b' was 'yes.')

#### **6. Fatigue or loss of energy**

- a. During that [worst/most recent] period of time, did you feel tired or low in energy nearly every day, even when you had not been working very hard? (AD26J/ADWRENRG)

A respondent was assigned a positive response to this symptom (D\_MDEA6/AD\_MDEA6=1) if he or she answered yes to the above question.

## **7. Feelings of worthlessness**

a. Did you feel that you were not as good as other people nearly every day? (AD26U/ADWRNOGD)

i. (if AD26U=1) Did you feel totally worthless nearly every day? (AD26V/ADWRWRTH)

A respondent was assigned a positive response to this symptom (D\_MDEA7/AD\_MDEA7=1) if he or she answered yes to question 'ai.' (Note that 'ai' was only asked if 'a' was 'yes.')

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## **8. Diminished ability to think or concentrate or indecisiveness**

1. During that [worst/most recent] period of time, did your thoughts come much more slowly than usual or seem confused nearly every day? (AD26P/ADWRTHOT)
2. Did you have a lot more trouble concentrating than usual nearly every day? (AD26R/ADWRCONC)
3. Were you unable to make decisions about things you ordinarily have no trouble deciding about? (AD26S/ADWRDCSN)

A respondent was assigned a positive response to this symptom (D\_MDEA8/AD\_MDEA8=1) if he or she answered yes to any of the above questions.

## **9. Recurrent thoughts of death or recurrent suicide ideation**

1. Did you often think about death, either your own, someone else's, or death in general? (AD26AA/ADWRDLOT)
2. During that period, did you ever think it would be better if you were dead? (AD26BB/ADWRDBTR)
3. Did you think about committing suicide? (AD26CC/ADWRSTHK)
  - i. (if AD26CC=1) Did you make a suicide plan? (AD26DD/ADWRSPLN)
  - ii. (if AD16CC=1) Did you make a suicide attempt? (AD26EE/ADWRSATP)

A respondent was assigned a positive response to this symptom (D\_MDEA9/AD\_MDEA9=1) if he or she answered yes to any of the above questions.

Respondents were classified with lifetime MDE (AMDELT=1 for adults) if they had at least five of the nine above attributes (DSMMDEA2/ADSMMDEA=1 for adults). Respondents were classified with not having lifetime MDE (AMDELT=2 for adults) if they met either of these conditions:

1. Reported experiencing fewer than five out of the nine criteria used to define an adult as having had MDE in their lifetime (DSMMDEA2/ADSMMDEA=2).
2. If the number of criteria is unknown (DSMMDEA2/ADSMMDEA=98) and the respondent reported at least one of the following:
  - I. Never having had a period of time lasting several days or longer when felt sad, empty, or depressed (ASC21/ADDPREV=2), discouraged about how things were going in life (ASC22/ADDSCEV=2), and lost interest in most things usually enjoyable (ASC23/ADLOSEV=2).
  - II. Experienced the feelings in (I), but they did not last most of the day, nearly every day for two weeks or longer (AD09/ADLSI2WK=2) or (AD12/ADDP2WK=2).
  - III. Experienced the feelings in (I) most of the day, nearly every day for two weeks or longer, but the feelings lasted less than an hour when mood was most severe and frequent (AD16/ADWRHRS=1).
  - IV. Experienced the feelings in (I) most of the day, nearly every day for two weeks or longer for at least an hour during those times when mood was most severe and frequent, but emotional distress was mild (AD17/ADWRDST=1),

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there was never a time when emotional distress was so severe that you could not be cheered up (AD18/ADWRCHR=4), and there was never a time when your emotional distress was so severe that you could not carry out your daily activities (AD19/ADWRIMP=4).

V. Experienced the feelings in (I) most of the day, nearly every day for two weeks or longer for at least an hour and the severe distress were more than mild or at some point could not be cheered up or could not carry out daily activities, but never had any other problems during those weeks, such as changes in sleep, appetite, energy, the ability to concentrate and remember, or feelings of low self-worth (AD21/ADDP2WK=2). 3