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## The Effects of Sugar on Mental Health in Marijuana Smokers

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# THE EFFECTS OF SUGAR ON MENTAL HEALTH IN MARIJUANA SMOKERS

An Honors Thesis

Presented to

The Department of Psychology  
Of the University of New Orleans

In Partial Fulfillment

of the Requirements for the Degree of  
Bachelor of Science, with University Honors  
and Honors in Psychology

by

Megan N. Long

May 2013

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## Abstract

This research study examined the effects of high levels of sugar intake on mental health in marijuana smokers. Because the literature demonstrates a similarity between refined sugar and other commonly addictive drugs, those who ingest a higher percentage of dietary sugar will score more poorly on the DASS21, meaning that with higher levels of sugar ingestion, a greater deficit in mental health functioning will be measurable. Of 16 participants, nine were female and seven were male, and the participants ranged from a normal weight to obese. The results did support the hypothesis of sugar dependence. This has implications for future studies on the impact of sugar on mental health. The results to this study may provide insight into potential for greater understanding of eating disorders associated with sugar dependence, thereby potentially leading to the development of more effective treatment options.

Keywords: Sugar, Substance Use, Substance Dependence, Comorbid Substance Abuse, Anxiety, Addiction

## The Effects of Sugar on Mental Health in Marijuana Smokers

### Introduction

Sugar is an important part of the human diet in order for the body to function properly. However, with the immense popularity of foods high in refined sugar and low in nutrients, people are beginning to create imbalances in their bodies, which can be reflected in their mental health. With the immense over consumption of refined sugar, it is possible that some individuals with a predisposition for addiction may become dependent on refined sugar, as they would any other addictive substance, such as marijuana.

### Literature Review

People who abuse various substances often face negative consequences for their actions. As this abuse turns to dependence, serious psychological issues may result. Typically, most people only consider alcohol, tobacco, and illicit drugs as those that place people at risk for dependency. It is frightening to think that a nutrient could be a source of concern, but the effects that sugar has on mental health, when consumed in excessive amounts, are similar to that of other drugs that lead to dependency. With excessive sugar consumption and dependence, it is likely that psychological issues such as depression, anxiety, and stress will be present in the individuals. Placing sugar in the same category of other drugs is of note because of how widespread this issue has become. If sugar is indeed a substance that people can become dependent on, then it is likely that those who already have a tendency for dependence to other substances would also develop a sugar dependency. Marijuana is a substance that is used in a more widespread manner, so it is

plausible to hypothesize that those who use marijuana more often are more likely to have a concurrent dependence on sugar.

First of all, it is important to better understand what is meant by the terms “abuse” and “dependence” in order to classify sugar as one of these substances. Kranzler and Li (2008) discussed the various definitions of substance abuse, dependence, and addiction. This research focuses on using the terms “abuse” and “dependence,” as does the DSM III as well as the DSM IV-TR because of the negative connotations associated with the term “addiction” (Kranzler & Li, 2008, p. 93). This article defines addiction as, “addiction captures the chronic, relapsing, and compulsive nature of substance use that occurs despite the associated negative consequences” (Kranzler & Li, 2008, p. 94). This is different from substance dependence, which can occur even when substances are used for therapeutic purposes. While this article did not include sugar as one of the substances that may cause dependence or addiction, it is logical to hypothesize that sugar would follow the same results because of the high likelihood of dependence that can be found from other studies. Because of the intense cravings and withdrawal symptoms people can experience from sugar, it is likely that these same issues would arise in the study of sugar abuse and dependence.

Animal studies can help to demonstrate the effects of sugar in a controlled setting. For example, Wilson (2010) presents the idea of sugar addiction. He writes about an animal study, in which rats that become addicted to sugar in his analysis of an experiment completed by Hoebel, Avena, Bocarsly, & Rada (2009). He states that these rats, when deprived of a sugar water solution experienced withdrawal, “demonstrated by opioid system activation reflected in elevated anxiety following sugar deprivation,” and craving,

“‘craving’ as the consumption of excessive sugar-water when given the opportunity following deprivation” (Wilson, 2010, p. 342). Although this study takes place in rats, it is likely that the same results would be seen in humans because of the similarities between the addiction patterns in the brains of both rats and humans. In another animal study reviewing a study involving rats that consume a diet of foods high in refined carbohydrates, the author asserts that an addiction to sugar is a definite possibility (Epstein & Shaham, 2010, p. 530). The study by Johnson and Kenny that Epstein and Shaham examined used the approach common to drug-addiction research examples. There were three groups of rats to be used for comparison: one with a typical rat chow diet, one with limited access to the “cafeteria style” diet, and one with over 40 days of extended access to the poor diet. The cafeteria style diet was high in sugar. In the group with extended access of over 40 days to the “cafeteria style” diet, the researchers measured an interruption of the reward response in the hypothalamus. According to the research, similar responses as shown to the high amounts of sugar can be found in humans who use substances known to be addictive, such as cocaine and heroin. The same group of rats also exhibited insensitivity to a stimulus that induced fear in the other groups of rats, which is another typical response that humans have to addictive substances (Epstein & Shaham, 2010, p. 530). This article makes many parallels between animal and human addictions, which helps to more deeply understand the scope of the effects sugar can have if an animal or person becomes addicted.

Studies in humans are important in order to understand how the data collected in animal studies relates to people. One example of the link between diet and mental health, Peet’s (2004) study used previous research data to report any correlations found between

diet and psychological conditions. He noted that a high intake of refined sugar could be correlated with a worsening of schizophrenia. He also found a relationship with sugar consumption and a higher prevalence of depression. As to the worsening of schizophrenia, patients who reported a higher consumption of refined sugar were more likely to be hospitalized for the disease (Peet, 2004, p. 406). Although these correlations were found, it was also mentioned that, “association does not prove causation,” which means that although it cannot be said that the increased sugar caused the worsening of these diseases, they are indeed related in some manner (Peet, 2004, p. 407). The results to Peet’s study demonstrate the awful effects sugar can have on mental health. Because of these results, it is likely that those who consistently consume high amounts of sugar will have a large impact on their mental health, especially if they already exhibit a deficit in their psychological wellbeing.

Foods high in sugar have been shown to correlate with higher instances of anxiety and depressive disorders. In women with osteoporosis, researchers gathered extensive dietary information over the course of one year as well as a survey of psychological wellbeing and found a relationship between anxiety, depression, and more westernized diets (Jacka, Pasco, Mykletun, Williams, Hodge, O’Reilly, Kotowicz, and Berk, 2010, p.306). A westernized diet consisted of higher amounts of, “processed or fried foods, refined grains, sugary products, and beer” than did traditional diets. Because of the types of foods considered to be the westernized diet, these women consumed high amounts of sugar, which was correlated with deterioration in mental health status. These women were more likely than those on traditional diets to have higher levels of anxiety and depression. The results from this study help to demonstrate the effects that sugar can have that are similar



to those of other drugs. This research provides more insight into the large effect sugar has on mental well-being.

Buchanan (1984) discusses the toxins found in food as well as the potential effects that these substances can have on users. He says that many scientists disagree on the effects of sugar in refined foods, but that the effects can have, in actuality, serious implications on health. Overconsumption of sugary foods upsets homeostasis for several interesting reasons. In order to function properly, the human body requires sugar. The main difference between natural sugars found in fruits and other foods and refined sugar is that natural sugars, “provide metabolites such as vitamins and minerals,” whereas refined sugars lack all of these benefits (Buchanan, 1984, p. 1327). Without the vitamins and minerals, the body does not receive necessary nutrients for maintaining a homeostatic environment. Because the body has to work harder to take the nutrients in natural sugars from other body tissues, refined sugar consumption “inevitably influences mental functioning” (Buchanan, 1984, p. 1328). In an effort to classify sugar as a toxin, the most susceptible group is noted: children. Because children do not usually have a clear understanding of metabolism, they are more likely to consume excessive amounts of refined sugar, as well as feel the negative effects that the homeostatic imbalance can induce. The research among children helps to demonstrate the serious effects high amounts of sugar can have on mental health. Due to the homeostatic imbalance created when excessive refined sugar is ingested, at least moderate deficiencies in mental functioning can be seen.

Ingestion of sugar can cause many negative changes in the body. As noted earlier, sugar creates a homeostatic imbalance when eaten in large amounts. One way in which

sugar can cause harm in individuals can be seen in Eatough, Shirtcliff, Hanson, and Pollak's article (2009). This research study did not have intention of measuring the effects of sugar in adolescents; it was actually measuring the hormonal reactivity to MRI scanning. Throughout the process of the study, the team collected saliva samples to measure the hormonal response to the stressful situations. What occurred stumped the scientists: after a lunch of pizza, the cortisol and DHEA levels reached their peak. Even after various stressful events, the highest level of stress occurred after the adolescents ingested the sugar-rich lunch. These results can be understood to show that the high amounts of refined sugar in pizza resulted in a spike in the stress response. Because of the harmful effects of a high stress response, it can easily be inferred that a sugar-rich diet in the presence of stress can cause a heightened response, which inevitably leads to a decline in mental health. This is due to both the harmful effects stress has on the body as well as the effects sugar has on functioning.

Much research has been done in recent years on the concept of "food addiction." In many cases, this concept is used when attempting to understand some of the more chronic cases of obesity. As Avena and Gold (2011) state, it has been difficult to create widespread support to "categorize food, which is something we all need to consume in order to survive, with drugs of abuse, which are generally considered along with other 'natural reinforcers' such as sex, to be very different from gambling, alcohol and illicit drugs" (Avena & Gold, 2011, p. 1214). In this article, Avena and Gold discuss the need for understanding of which foods are more likely to become addictive. They refer to, "'hyperpalatable' foods," which are, "rich in fats, sugars and/or salts, which are often comprised of synthetic combinations of many ingredients, may have greater addictive

potential than traditional foods such as fruits, vegetables and lean protein” (Avena & Gold, 2011, p. 1215). They hypothesize that these foods are at the heart of the obesity epidemic that is currently facing westernized society today. Also, they cite studies that support their hypothesis, in which these sugar-rich foods contribute to behavior similar to that seen in other instances of addiction.

Another example of research on sugar addiction, Fortuna’s article (2010) discusses similarities of sugar addiction to those with a familial history of alcohol dependence. Interestingly, he cites “Janowsky and colleagues (2003) noted a greater sweet preference in cocaine-dependent patients when compared to nonaddicted controls” (Fortuna, 2010, p. 149). He also notes a higher likelihood of sweet preference in those who are also highly dependent on alcohol. He also looks at the possibility of a genetic variable that may increase the likelihood of sugar preference. He states that, “many bulimic and obese individuals have a sweet preference and self-medicate with a variety of sweets and sugars to activate reward pathways (i.e., dopamine, beta-endorphin) like many alcohol- or drug-dependent individuals” (Fortuna, 2010, p. 149). He talks about a gene that has been linked to a higher propensity for alcohol dependence or other substance abuse, and suggests that this gene may lead to the likelihood that certain individuals will become sugar dependent. Because of this research, it is possible to see links between a dependency on sugar and other dependencies.

Because of the research on sugar and other drugs, it is interesting to understand the likelihood of concurrent dependencies. The effects other substances known to be commonly abused and depended on have on mental functioning are also important in order to understand if sugar indeed fits into this category. Bonn-Miller and Zvolensky

(2009) conducted a research experiment concerning anxiety responses in individuals with marijuana abuse and dependence. It is proposed that the changes marijuana makes in the brain helps to induce a fear response, leading to a higher instance of panic attacks. This article sorted participants into three categories: marijuana users, marijuana abusers, and marijuana dependents. If a person has a strong predisposition to become dependent on marijuana, the likelihood increases for comorbid addictions to other substances. Because sugar also is correlated with an increase in anxiety, these two factors together might lead to a high instance of anxiety when both are used in excess.

Cooper and Haney (2008) look into the extent of use and abuse of marijuana. It is the most highly used illicit drug worldwide, and those who do seek treatment seem to have little success in overcoming the addiction. In fact, “most (90%) of those who seek treatment do not succeed in remaining abstinent” (Cooper & Haney, 2008, p. 188). Users even report symptoms of withdrawal when they stop taking the marijuana. There is evidence to support the idea that, “daily marijuana smokers find it difficult to control their use of the drug, are distressed about the habit and experience withdrawal upon abstinence” (Cooper & Haney, 2008, p. 188). The use of marijuana also has reinforcing and rewarding effects, which leads 10% of generalized population smokers to become daily users and 20% of youth smokers to make marijuana a daily habit. This article helps to reinforce the evidence of the qualities that cause people to become dependent on this substance.

After carefully considering the above research, it is plausible to hypothesize the strong likelihood of comorbidity of marijuana use and sugar dependence. Both substances cause similar changes in mental functioning when used in excess, so it is likely that those

who are dependent on both would show strong deficits in mental functioning. Such individuals would likely have high levels of depression, anxiety, and stress.

## Method

### *Participants*

In this research project, sixteen marijuana smokers were recruited by referential sampling. Nine females and seven males participated in the research study.

### *Materials*

Participants were asked to use a dietary tracking website or application, such as “Calorie Counter- MyFitnessPal,” on their phone or other mobile device. This application allows web syncing to allow for the most convenient use. If they did not have access to a smart phone, the website, “sparkpeople.com” was a suggestion. The DASS21 was also used in the online questionnaire used for this study. A copy of the DASS21 can be found in Appendix I. The online questionnaire that participants completed can be found in Appendix II.

### *Procedures*

For three days, participants were asked to track the foods they eat and the amount of marijuana used each day on the dietary tracking application or website. The participants then enter this information into an online questionnaire. On day two, participants will also the shortened version of the Depression, Anxiety, and Stress Scale. Anonymity was kept through the use of a code name, which will be entered into each day’s questionnaire. After data collection was completed, SPSS was used to find a

statistical correlation between the amount of sugar ingested and the DASS score. In order to compare participants in a standardized manner, the percentage of sugar calories of the total calories was calculated by dividing the number of sugar calories by the number of total calories

## Results

Analysis of the data showed different types of people participating in the study. Of the 16 participants, nine were females and seven were males. One participant admitted to smoking marijuana only once per week on average, while all of the remaining participants admitted to smoking at least three times per week on average, with a mean of 4.62 and a standard deviation of 1.71 uses of marijuana in an average week. Participants' age ranged from 20 years old to 52 years old with a mean of 29.75 years, with a standard deviation of 8.94. Participants varied on amount of exercise as well, with a mean of 105 minutes per week and a standard deviation of 113.09. As for BMIs, participants ranged from 21, which is normal, to 36, which is obese. The mean for BMI was measured to be 26.44, which is slightly overweight, with a standard deviation of 4.43. As for other drugs, only a few participants admitted to alcohol or tobacco use on a regular basis. As for DASS 21 scores, a range of 10 to 46 was recorded, with a mean of 30.25 and a standard deviation of 10.00. The DASS 21 can be broken down into three groups: stress, anxiety, and depression. The stress scores ranged from 0 to 16, with a mean of 10.69 and a standard deviation of 4.74. Anxiety scores ranged from 3 to 16, with a mean of 9.94 and a standard deviation of 3.49. Depression scores ranged from 1 to 14, with a mean of 9.63 and a standard deviation of 3.63.

It was possible to calculate the percent of sugar in each participants' diet. From this, BMI was measured to have a positive correlation with the percent of sugar in the diet using Pearson's correlation ( $r= 0.59, p= 0.017$ ). A graph of this can be seen in Figure II. The DASS 21 total score was also positively correlated with percent of sugar in the diet with ( $r= 0.76, p=0.001$ ). BMI was not shown to correlate with the DASS 21 total score ( $r=0.27, p=0.318$ ).

Several gender differences were observed. For example, the mean percent of sugar in the diet was 27% in men, while it was measured at 17% for females ( $F=2.53, p=0.134$ ). Also, as expected due to size differences, males had higher height and weight than women. Men had a mean BMI of 29.29, while women had a mean BMI of 24. This result is not significantly different, but is interesting to note ( $F=1.007, p=0.333$ ). While these results are not significantly significant, it is important in understanding the relative size between male and female participants.

A positive correlation was found between total calories and the total number of times participants use marijuana in a given week ( $r= 0.61, p=0.011$ ), Percent of sugar in diet was correlated with the total number of marijuana uses per week ( $r= 0.55, p=0.027$ ). A graph of this phenomenon can be found in Figure III. Total sugar was correlated with the DASS 21 score ( $r= 0.74, p=0.001$ ). A graph of the correlation between percent sugar and DASS21 total scored can be found in Figure I. The DASS 21 score was also positively correlated with total marijuana uses per week ( $r= 0.66, p=0.005$ ). Interestingly, the stress component of the DASS 21 did not correlate with total marijuana use per week ( $r=0.45, p=0.084$ ). DASS Anxiety scores correlated with total marijuana use per week ( $r= 0.60, p=0.014$ ). DASS Depression scores correlated with total marijuana use per

week ( $r = 0.66, p = 0.005$ ). DASS 21 Anxiety scores correlated with percent sugar ( $r = 0.83, p = 0.000$ ). DASS 21 Depression scores correlated with percent sugar ( $r = 0.64, p = 0.008$ ). Total calories correlated with DASS 21 Depression scores with a ( $r = 0.59, p = 0.017$ ). Percent of Sugar in diet was correlated with all three variables of the DASS21, with  $r$  values for each as follows: percent sugar and stress were correlated at  $r = 0.51, p = 0.042$ , percent sugar and anxiety were correlated with  $r = 0.83, p = 0.000$ , and percent sugar and depression with  $r = 0.64, p = 0.008$ . Controlling for the total marijuana use per week, Anxiety subscores still correlate with total sugar ( $r = 0.63, p = 0.012$ ).

### Discussion

The results of this research study support the hypothesis of a relationship between sugar and mental health dysfunction. Surprisingly, stress did not correlate with sugar intake, but anxiety and depression did indeed increase with sugar intake. It is important to realize the strong effect sugar has on anxiety. Even with marijuana use as a control, a positive correlation was still measured between anxiety and the percent of sugar taken in. This sample is interesting because it consisted of casual to moderate marijuana users. The group, on average, took in high levels of sugar, and they exercised moderately.

Gender differences and similarities were noticeable. As can be expected, males were larger in height and weight than females. Men also had much higher BMIs than women, although this was not statistically significant. Men tended to be heavier marijuana smokers than women, and they also took in a higher percentage of sugar in their diet. Though these gender differences are not statistically significant, they are important in understanding the size of the participants.



These results are significant because they not only support the idea of comorbid dependence, but also shed light on the major issue of sugar dependence. Although the total number of participants is small, it was necessary to make that sacrifice in order to collect more data. Because of the large time commitment requested from participants, it was difficult to find participants. One other flaw is that no occupational information was reported, which could influence the results.

### Conclusion

This study supports the concept of sugar dependence due to the effects of sugar especially on anxiety levels that increase with percent of sugar, even when marijuana use is controlled for. While the marijuana use may affect the results, significant correlations were found even when the use of marijuana was controlled for. In further studies, an example of a group that has a dependency on alcohol as well as a group with a dependency on marijuana would be interesting to observe because of Fortuna's potential genetic link between alcohol dependence and sugar dependence.

This study can lead to further research in understanding sugar dependence. Possible studies could include measuring hormone reactivity to sugar. It would be interesting to measure reactivity to stress in individuals who ingest higher percentages of sugar in their diet as compared to those who do not. Another interesting study could be done in comparing a lack of refined sugar in the diet, as opposed to those who intake much refined sugar.

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## Appendix I:

|   |  |                            |
|---|--|----------------------------|
| <h1 style="margin: 0;">DASS<sub>21</sub></h1>   |  | Name: _____<br>Date: _____ |
| <p>Please read each statement and circle a number 0, 1, 2 or 3 that indicates how much the statement applied to you <i>over the past week</i>. There are no right or wrong answers. Do not spend too much time on any statement.</p> <p><i>The rating scale is as follows:</i></p> <p>0 Did not apply to me at all<br/>         1 Applied to me to some degree, or some of the time<br/>         2 Applied to me to a considerable degree, or a good part of time<br/>         3 Applied to me very much, or most of the time</p> |  |                            |
| 1   | I found it hard to wind down   | 0 1 2 3                    |
| 2   | I was aware of dryness of my mouth   | 0 1 2 3                    |
| 3   | I couldn't seem to experience any positive feeling at all  | 0 1 2 3                    |
| 4   | I experienced breathing difficulty (eg, excessively rapid breathing, breathlessness in the absence of physical exertion) | 0 1 2 3                    |
| 5   | I found it difficult to work up the initiative to do things  | 0 1 2 3                    |
| 6   | I tended to over-react to situations   | 0 1 2 3                    |
| 7   | I experienced trembling (eg, in the hands)   | 0 1 2 3                    |
| 8   | I felt that I was using a lot of nervous energy  | 0 1 2 3                    |
| 9   | I was worried about situations in which I might panic and make a fool of myself  | 0 1 2 3                    |
| 10  | I felt that I had nothing to look forward to   | 0 1 2 3                    |
| 11  | I found myself getting agitated  | 0 1 2 3                    |
| 12  | I found it difficult to relax  | 0 1 2 3                    |
| 13  | I felt down-hearted and blue   | 0 1 2 3                    |
| 14  | I was intolerant of anything that kept me from getting on with what I was doing  | 0 1 2 3                    |
| 15  | I felt I was close to panic  | 0 1 2 3                    |

|    |  |   |   |   |   |
|----|--|---|---|---|---|
| 16 | I was unable to become enthusiastic about anything   | 0 | 1 | 2 | 3 |
| 17 | I felt I wasn't worth much as a person   | 0 | 1 | 2 | 3 |
| 18 | I felt that I was rather touchy  | 0 | 1 | 2 | 3 |
| 19 | I was aware of the action of my heart in the absence of physical exertion (eg, sense of heart rate increase, heart missing a beat) | 0 | 1 | 2 | 3 |
| 20 | I felt scared without any good reason  | 0 | 1 | 2 | 3 |
| 21 | I felt that life was meaningless   | 0 | 1 | 2 | 3 |

## Appendix II:

*The Effects  
of Sugar on  
Mental  
Health*

Hello. Thank you for participating in this research study. For this study, please record your diet for three days. I strongly suggest you use a free downloadable application such as Myfitnesspal or Fooducate to help you track the name of the item, the number of calories, and the amount of sugar in each item that you eat or drink. If you do not have access to a smartphone, Myfitnesspal also has an internet component. The site [sparkpeople.com](http://sparkpeople.com) is another option. Over the course of three days, please enter your information along with a code name to associate your name with your data. This code name should have no personal information in it as to keep yourself anonymous. The results from this questionnaire will be in no way linked to those who volunteer for participation. After entering the demographic information, there will be a short questionnaire to assess mental functioning. This questionnaire is to be taken only on day 2 of the participation. Thank you again for participating. Please state the code name that you will use for each of the three days of data collection.

Is this day 1, 2, or 3 of your participation?

☐

1

☐

2

☐

3

What is your age?

Are you male or female?

☐

Male

☐

Female

Please enter your height in inches.

Please enter your weight.

How many minutes per week do you typically exercise?

Please state each item you have eaten or drank today, along with the number of calories and the amount of sugar in the box below.

How many times per week do you typically use marijuana? If zero, please place a 0 in the blank.

Have you, or will you, use marijuana today?

Do you use any other drugs (including alcohol)? If so, please list with the number times per week you use the substance.

Below is the survey only to be taken on Day Two of your participation. Please read each statement and select the circle representing a number 0, 1, 2 or 3 which indicates how much the statement applied to you over the past week. There are no right or wrong answers. Do not spend too much time on any statement. The rating scale is as follows: 0 Did not apply to me at all - NEVER 1 Applied to me to some degree, or some of the time - SOMETIMES 2 Applied to me to a considerable degree, or a good part of time - OFTEN 3 Applied to me very much, or most of the time - ALMOST ALWAYS

I found myself getting upset by quite trivial things

☐

0

☐

1

☐

2

☐

3

I was aware of dryness of my mouth

☐

0

☐

1

☐

2

☐

3

I couldn't seem to experience any positive feeling at all

☐

0

☐

1



2



3

I experienced breathing difficulty (eg, excessively rapid breathing, breathlessness in the absence of physical exertion)



0



1



2



3

I found it difficult to work up the initiative to do things



0



1



2



3

I tended to over-react to situations



0



1



2



3

I experienced trembling (eg, in the hands)



0



1



2





3

I felt that I was using a lot of nervous energy



0



1



2



3

I was worried about situations in which I might panic and make a fool of myself



0



1



2



3

I felt that I had nothing to look forward to



0



1



2



3

I found myself getting agitated



0



1



2



3

I found it difficult to relax



0



1



2



3

I felt down-hearted and blue



0



1



2



3

I was intolerant of anything that kept me from getting on with what I was doing



0



1



2



3

I felt I was close to panic



0



1



2



3

I was unable to become enthusiastic about anything



0



1



2



3

I felt I wasn't worth much as a person



0



1



2



3

I felt that I was rather touchy



0



1



2



3

I was aware of the action of my heart in the absence of physical exertion (eg, sense of heart rate increase, heart missing a beat)



0



1



2



3

I felt scared without any good reason



0



1



2



3

I felt that life was meaningless



0



1



2



3

Figure I:

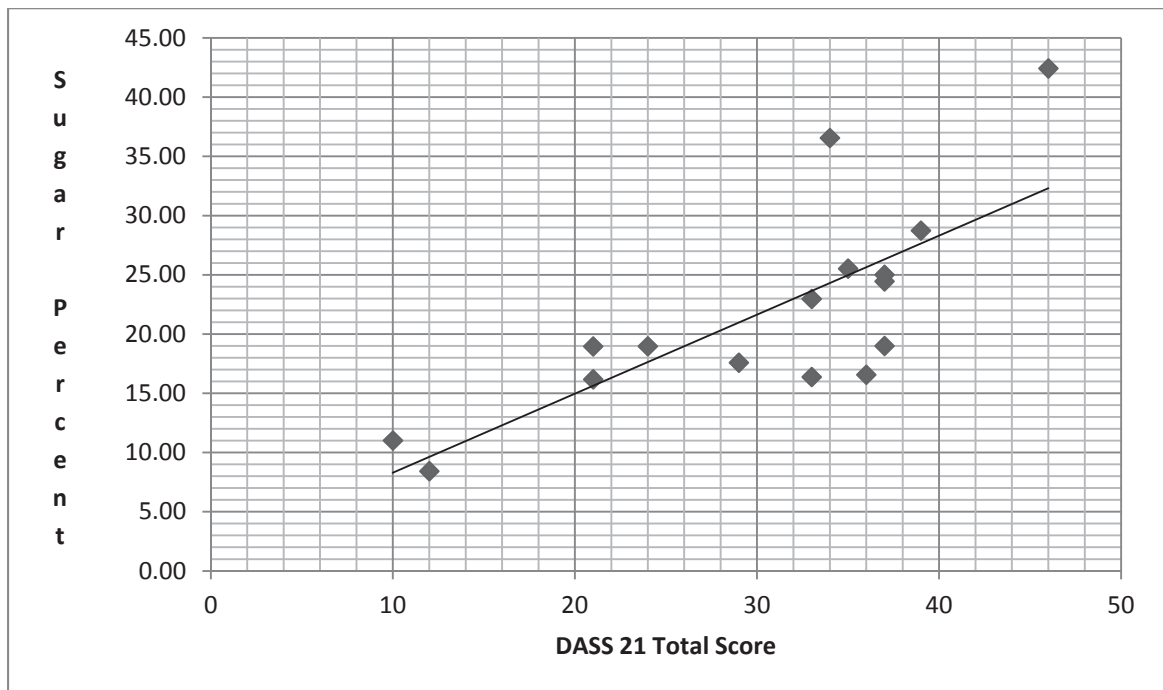


Figure II:

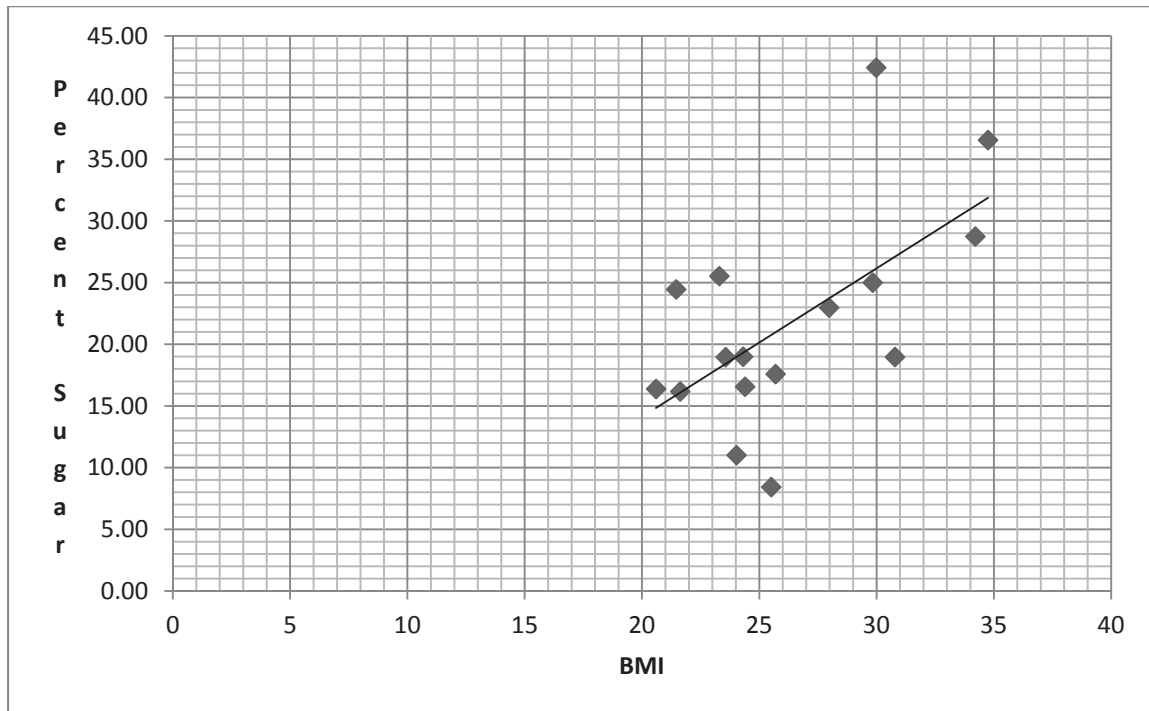
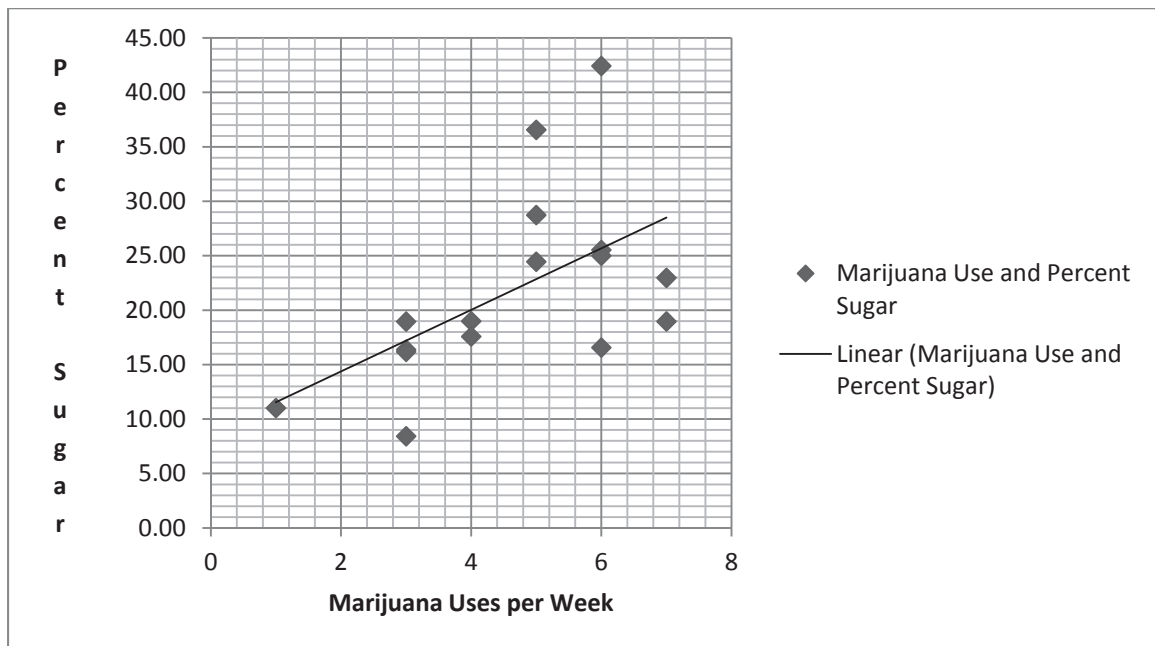


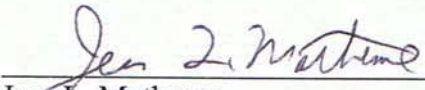
Figure III:




## APPROVAL SHEET

This is to certify that Megan Nicole Long has successfully completed her Senior Honors Thesis, entitled:

*The Effects of Sugar on Mental Health in Marijuana Smokers*

 Director of Thesis  
\_\_\_\_\_  
Jess L. Matherne

 for the Department  
\_\_\_\_\_  
Elizabeth A. Shirtcliff

 for the University  
\_\_\_\_\_  
Abu Kabir Mostofa Sarwar Honors Program

May 1, 2013  
Date