

THE ASSOCIATION BETWEEN ADDED SUGAR CONSUMPTION AND MAJOR  
DEPRESSION IN ADULT WOMEN

A thesis submitted to the faculty of  
San Francisco State University  
In partial fulfillment of  
the requirements for  
the Degree

AS

36

2017

HOMECE

• F57

Master of Art

In

Family Interiors Nutrition and Apparel

by

Adi Fish

San Francisco, California

January 2017

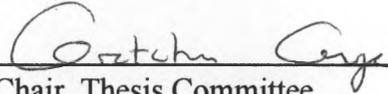
Copyright by  
Adi Fish  
2017

THE ASSOCIATION BETWEEN ADDED SUGAR CONSUMPTION AND MAJOR  
DEPRESSION IN ADULT WOMEN

Adi Fish  
San Francisco, California  
2017

The purpose of this study was to examine the association between added sugar consumption and levels of major depression in adult women. The Patient Health Questionnaire-9 depression scale and the Block Fat/Sugar/Fruit/Vegetable Screener were used to collect data, along with knowledge questions about added sugar, and a question regarding nutrition support when seeking mental health treatment. Data was collected from a sample of 74 women ages 18-55 living in the United States through a Facebook link. The main findings of the study were an association between added sugar consumption and levels of depression,  $r=.389, p<.05$ . Results of the knowledge portion of the survey show that participants did not have a strong understanding of added sugar, as 48.6% received a “low” score. The self reported surveys reveal that 67.5% of participants who sought mental health treatment were not given specific nutrition recommendations. The findings in this specific study provide evidence that of an association between levels of added sugar intake and major depression levels in women.

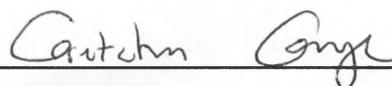
I certify that the Abstract is a correct representation of the content of this thesis

  
\_\_\_\_\_  
Chair, Thesis Committee

12/19/17  
\_\_\_\_\_  
Date

CERTIFICATION OF APPROVAL

I certify that I have read *The Association Between Added Sugar Consumption and Major Depression in Adult Women* by Adi Fish, and that in my opinion this work meets the criteria for approving a thesis submitted in partial fulfillment of the requirement for the degree Master of Arts in Family Interiors Nutrition and Apparel at San Francisco State University.



---

Gretchen Lynn George, PhD., RD  
Assistant Professor, Family Interiors



---

Karen Carroll-Johnson, PhD.  
Professor, Family Interiors

## ACKNOWLEDGEMENTS

I would like to express my sincere gratitude to my thesis advisor, Dr. Gretchen George, for her patience, continuous support, and mentorship; and to Dr. Karen Johnson-Carroll for her guidance, valuable input, and encouragement. Without them, this experience would not have been as memorable and positive. A special thank you to the friends and family who assisted in survey distribution, and to all San Francisco State University staff who contributed to this study.

I would like to dedicate this publication to my family: Avner, Micka, and Itai Fish, for supporting me endlessly in my education and life, and always showing earnest interest in my research.

Lastly, I would like to thank my partner, Robert Williamson, who supported me throughout this degree, and far beyond.

## TABLE OF CONTENTS

List of Table .....	ix
List of Appendices.....	x
Introduction .....	1
Hypothesis and Objectives .....	2
Terminology .....	2
Review of Literature.....	3
Depression .....	3
Depression Statistics in Women.....	3
Depression Statistics in Women of Various Ethnicities and Races .....	4
Depression and Obesity.....	6
Sugar and Addiction .....	10
Depression and Physical Activity.....	11
Dietary Patterns in the U.S. ....	13
Recommendations and Patterns.....	13
Added Sugar Definition.....	14
Added sugar.....	15
Added Sugar Intake and Depression .....	16
Depression, Diet, and the Microbiome.....	19
Depression Measures.....	21
Diet Measures.....	22
Dietary Recommendations for MDD .....	24

Method.....	25
Study Design .....	25
Sample Size and Power Analysis .....	25
Recruitment .....	25
Inclusion Criteria .....	26
Enrollment .....	26
Measurement Instrument .....	26
Statistical Analysis .....	27
Results .....	28
Participant Demographic Characteristics .....	28
Added Sugar Knowledge Questions.....	30
Participant Reported Depression .....	31
Participant Added Sugar Intake.....	31
Participant Sugar Intake and Depression Levels .....	32
Participant BMI Category and Added Sugar Intake.....	34
Participant BMI Category and Nutrition Advice.....	35
Discussion.....	43
Added Sugar Intake .....	37
Nutrition Knowledge .....	38
Nutrition Advice for Participants Who Sought Professional Depression Help.....	40
BMI and Added Sugar .....	41
Diet and Mood.....	41
Implications .....	42

Limitations.....	43
Future Research and Conclusion.....	43
Reference.....	45
Appendices .....	55

## LIST OF TABLES

Table	Page
1. Demographic Characteristics of Participants.....	28
2. Participant BMI.....	30
3. Added Sugar Knowledge.....	30
4. Participants' Depression Category Based on PHQ-9 Score.....	31
5. Participants' Added Sugar Intake in Grams.....	32
6. Pearson Correlation Analysis of Participants' Daily Added Sugar Intake Above Recommended 25 Grams by the American Heart Association and PHQ-9 Results Above Normal.....	33
7. Scatterplot of Participants PHQ-9 Raw Score Compared to Added Sugar Intake in Grams.....	34
8. Scatterplot of Participant Added Sugar Intake in Grams Compared to BMI...	35
9. Participant BMI Compared to Professional Nutritional Advice Received.....	36

## LIST OF APPENDICES

Appendix	Page
1. Recruitment Script for Facebook Support Group Pages.....	55
2. Recruitment Script for Facebook Personal Page and Congregation.....	56
3. Implied Consent Form .....	57
4. Survey .....	58

## Chapter 1

### Introduction

Major depression affects 6.7% of adults in the United States, approximately 14.8 million people. This condition is the second most prevalent cause of disability induced by illness (Ripoll, 2015). Interestingly, women are twice as likely as men to suffer from depression (Johnson et al., 2014).

Research has found that frequent consumption of processed food is associated with an increased risk of depression (Sanches-Villegas et al., 2012), and higher blood sugar levels in the body are a risk factor for depression (Gangwisch et al., 2015). Just as diet has an effect on physical health, it also may have a bi – directional relationship with mental illness (Lopresti, Hood, & Drummond, 2013).

Knowing these facts, it may be important to evaluate the effects of added sugar on depression in women, specifically premenopausal adult women, in order to determine if adjusted levels of added sugar intake can be used to lower the prevalence of depression.

### **Hypothesis and Objectives**

The purpose of this study was to determine if there is an association between added sugar intake and major depressive disorder (MDD) in women (age 18-55) living in the United States. The primary hypothesis of this study is participants' added sugar intake is related to their levels of MDD. The measurable objective was to collect a food frequency questionnaire and a depression scale from study participants to analyze this relationship.

The secondary hypothesis is participants will have a poor understanding of added sugar as reflected in the knowledge question portion of the study survey. A third hypothesis is participants will not receive specific nutritional advice when seeking depression treatment from a health professional.

### **Terminology**

- Major Depressive Disorder (MDD) is a mental disorder characterized by continuous depressed moods and loss of interest in regular activities, causing impairment in daily life.
- Added Sugar is any sugar added to foods during processing or preparation.
- Diagnostic and Statistical Manual of Mental Disorders, fifth edition (DSM-5) is a professional manual for mental health practitioners used for identifying, describing, and diagnosing mental disorders using a standard way.
- Food Frequency Questionnaires are questionnaires used to estimate intake of various nutrients and foods by collecting data regarding the rate at which these nutrients and foods were consumed in a previous set amount of time, often 2 weeks.

## Chapter 2

### Literature Review

#### **Depression**

Depression is a broad term that defines multiple disorders. It is among the most common mental disorders in the United States (2016) and the second-leading cause of disability worldwide (Vos et al., 2012). The most common subset of depression is major depression, and is classified in the Diagnostic and Statistical Manual of Mental Disorders (DSM-5) as major depressive disorder (MDD). A diagnosis of MDD requires at least two weeks of general unhappiness or loss of interest or pleasure during day-to-day activities (American Psychiatric Association (APA), 2013). In addition, at least five of the following symptoms must be present on most days: feeling depressed or irritable, loss of interest in most activities, change in weight or appetite, change in sleep patterns, change in levels of activity, fatigue, increase in feelings of guilt or worthlessness, inability to concentrate, and suicidal thoughts or plans (DSM-5). To be considered a disorder, this change must cause social, occupational, or educational impairment (APA, 2013). Exact causes for most cases of depression are unknown, but according to the National Institute of Mental Health, major life change, trauma, and stress are risk factors.

#### **Depression statistics in women**

Women are twice as likely as men to suffer from major depression (National Alliance on Mental Illness, 2010). Though the exact number of women with depression is undetermined, although it is approximated at 12 million (Landau,

2017). While there is not an accepted explanation for this disparity, it is commonly attributed to hormonal differences between sexes (Albert, 2015), genes, stress, and cognitive differences, specifically in the amount of time men and women ruminate on things (Harvard Mental Health Letter, 2011).

When it comes to genetics and depression, it appears as though there is not one gene that creates a risk factor for depression. Instead, similarly to diabetes, it is affected by the interactions of multiple. The genetic component of depression is measured by family prevalence and risk, thus associative relationships; people who have a parent or sibling with depression are 2 to 3 times more likely to be depressed. It is not yet clear which genes are the ones that influence depression, or how that is connected to women being more likely to be depressed (Levinson & Nichols, 2017).

A meta-analysis on the gender difference in rumination, brooding, and reflection was conducted to analyze whether those may be a factor for depression. There were 57 total studies used, with 14,321 individual participant data. The researchers used Cohen's  $d$  to analyze whether there were gender differences in the results of the studies, and found significant results with a small effect size. Brooding and reflection were analyzed in 23 studies, which had 4873 total participants. Cohen's  $d$  was also calculated for these studies, and a significant small effect size was found for gender, which indicates women tend to brood and reflect more than men (Johnson & Whisman, 2013).

### **Depression statistics in women of various ethnicities and races**

Racial and ethnic differences in rates of depression have also been observed. According to the Centers for Disease Control (CDC), 8% of Non-Hispanic black Americans, 6.3% Mexican Americans, and 4.8% Non-Hispanic white Americans have depression when assessing the total United State population (CDC, 2013). Although racial and ethnic differences in women have been inconsistent (CDC, 2010), depression risk factors such as being in a lower socioeconomic status, receiving a lower education level, and racial/ethnic discrimination are noted to put women of color at a higher risk for depression (McGrath et al., 1990).

Suicidal thoughts or plans are two DSM-5 MDD symptoms. Sometimes, these thoughts and plans do lead to actual suicide attempts or suicide (University of California Santa Cruz, 2017). Asian Americans of college age have been found to have the highest rate of documented suicidal thoughts (Duldulao, Takeuchi & Hong, 2009). It is not clear exactly why Asian American adolescents experience higher levels, but Dinn & Caldwell-Harris (2016) illustrated it may be associated with collectivism, which is the practice of prioritizing the group or community over the individual. It may also be associated with higher parental control, which is when parents dictate what their children can or cannot do, both of which are often present in the Asian culture.

The number of attempted suicides in women of all ethnicities and races, ages 45-64, increased by 63% since 1999. When looking at all age groups, there were increases ranging from 31-53%, with the exception of women over 75 (Curtin, Warner, & Hedegaard, 2016). Although there are many reasons for attempting suicide, the American Psychiatric Association (2013) has noted that it is possible that the severity

of MDD in women has worsened over the past couple of decades, as suicidal thoughts, plans, and attempts, are possible symptoms for MDD.

### **Depression and obesity**

In the United States, 40.4% of women are obese (Flegal, Kruszon-Moran & Carroll, 2016). Obesity increases the risk for heart disease, type 2-diabetes, stroke, and some types of cancers (CDC, 2016), and is currently considered an epidemic (Mitchell et al., 2011). There is no simple treatment to obesity but health professionals commonly rely on prescribing lifestyle changes such as dietary modifications and physical activity and in serious cases may recommend bariatric surgery (National Institutes of Health, NIH, 2017).

The Weight Control and Diabetes Research Center, a subset of the NIH have developed behavioral treatment programs for obesity that focus on lifestyle changes. One in particular is called Look AHEAD. A main goal of this programs is calorie restriction to support weight loss. To achieve this primary goal, participants meet with health professionals (e.g. registered dietitian, health coach, and medical doctor) and are given calorie goals based on their baseline calorie intake in contrast to their current weight. The goal is to lose 1-2 pounds per week, which generally puts their caloric deficit between 500-1000 calories.

The next goal of the programs is modifying current physical activity habits. The goal for everyone enrolled is to increase activities to moderate intensity, such as walking swiftly, starting with 10 minutes per day, 5 days a week. The participants gradually

increase exercise to 30 minutes per day, still exercising 5 days a week. The program encourages participants to increase exercise to 200 or 250 minutes per week for better maintenance of weight loss.

Another goal of behavioral weight loss programs such as Look AHEAD is to provide strategies that help participants adhere to these newly prescribed diet and activity goals. This includes self-monitoring, which involves participants recording their own weight, diet, and activity every day. Participants are told to remove foods that are high in calories from their homes, set goals for themselves, and preplan to make meals and exercise easier (Olson, Dale, & Wing, 2017).

These behavioral weight loss programs produce approximately 15-20 pounds of weight loss on average, after about 6-12 months of following the program (Thomas & Bond, 2014). Out of all the different parts of the programs, the biggest predictor of success in reaching weight loss goals is if the participant adheres to the self-monitoring of dietary intake (Burke, Wang, & Sevick, 2011). The Look AHEAD program, along with other programs by the Weight Control and Diabetes Research Center, are national and widely referenced, and are a common perspective of how weight loss and a healthy diet should be approached (NIH, 2016).

Although there are several suggested theories and programs for successful weight loss treatment, one perspective is that obesity should be treated as a disease or an addiction (Allen et al., 2012). Onyike et al. (2003) examined, 8,410 American participants between the ages of 15-39 looking at any associations between weight and depression. The sample was made up of approximately half males and half females, and was primarily European American. The participants were measured for body mass index

(BMI) information by researchers, which then administered the Diagnostic Interview Schedule; a tool used to measure depression prevalence is large-scale studies, to assess participants' levels of depression. The results identified an association between severe obesity and higher levels of depression. Additionally obese participants were 1.5 times more likely than normal-weight participants to have had depression in the last month. In female participants, obesity was associated with an 82% increased likelihood of depression.

Another study, which examined the topic of obesity and mental health associations, analyzed data from 177,047 adult participants who had their BMI measured, along with depression levels assessed by the Patient Health Questionnaire-8 (PHQ-8) diagnostic algorithm. The PHQ-8 is almost identical to PHQ-9, which is discussed later in this thesis. The PHQ-8 rewrites DMS-5 symptoms of MDD and provides a Likert scale for participants to respond how often they have experienced each symptom in the last two weeks. The only difference between the PHQ-8 and the PHQ-9 is that the PHQ-8 does not ask about suicidal thoughts or self-harm. Results illustrated higher rates of obesity in participants with PHQ-8 determined levels of depression (Zhao et al., 2009).

As previously mentioned, women are twice as likely as men to suffer from MDD (National Alliance on Mental Illness, 2010). Additionally, women are more likely than men to be obese (CDC, 2017). While approximately 40.4% of women in the United States are obese, the rate for men is 35%. The gender difference is even starker in extreme obesity with a BMI of 40 and higher, while men are at 5.5%; the

rate for women is almost double at 9.9% (CDC, 2017). This contrast in rates between the genders mirrors that of in depression.

A study by Carpenter et al. (2000) analyzed gender differences between depression and BMI associations in a sample of 40,086 African Americans and European American participants. Levels of depression were determined using the Alcohol Use Disorders and Associated Disabilities Interview Schedule administered by a trained interviewer, and included questions regarding major depression. BMI data was calculated using the self reported height and weight information provided by the participants. The results of the study found that BMI was associated with major depression in both genders. In women, higher BMI was associated with higher levels of depression. However in men, lower BMI was associated with higher levels of depression

Physiological differences between men and women exist when it comes to obesity. A study collected brain image data from 61 men and 63 women, and researchers analyzed the brain's reward system, sensorimotor, and salience, which is the way the brain makes appropriate responses based on present stimuli (Gupta et al., 2017). What researchers found was that obese women showed more change in the reward system of the brain compared to women of normal weight and men, which suggests that emotional eating and compulsive eating may play a larger role in their overeating than in obese men experiencing the same stimuli.

The differences in obesity between men and women are also seen in different race and ethnicity groups, as well as socio-economic factors. A meta-analysis of NHANES III used data from 5,170 American males, and 5,762 American females. Participants were categorized into Non-Hispanic White, Non-Hispanic Black, Mexican American, and

other racial and ethnicity groups. Obesity was determined by calculating the BMI of participants from height and weight measurements. Participants with a BMI higher than 30 were considered obese, which is a standardized cut off (CDC, 2017). Socioeconomic status was measured by the self-reported family income of participants over the previous year. The results indicated that for women, obesity is associated with a lower socioeconomic status. In men, the results were reversed, and obesity was instead associated with a higher socioeconomic status (Zhang & Wang, 2004).

Data from the United States Department of Health and Human Services illustrated similar patterns relating to women and obesity. A data brief shows that women who lived in households in which income was at or about 350% of the poverty line were more likely to be obese. The rate was much higher for women living below 130% of the poverty line, where 42% were obese. This trend was similar across all races, however, it was only significant in non-Hispanic white women (Ogden et al., 2010).

### **Sugar and Addiction**

Obesity risk appears to differ among genders and socioeconomic status, and may have a relationship to diet and lifestyle. Recently, added sugar consumption has been identified to have a strong association with weight gain and obesity (CDC, 2017). A leading source of added sugar in the United States is from the consumption of sugar-sweetened beverages (CDC, 2017).

Through research, it has been discovered that sugar has addictive properties (Avena, Rada, & Hoebel, 2008). To fit into the criteria for addiction, a substance must involve craving and anticipation, bingeing and tolerance, and withdrawal

with negative emotions (Lustig, 2013). Sugar meets each of these criteria. One way sugar can be addictive involves the reward system in the brain, which works on dopamine (Stangor, 2011). There is an area of the brain called the reward center, in which the neurotransmitter dopamine sends signals of pleasure to the body. When one consumes high amounts of sugar, as is prevalent in Western diets such as the U.S., within 3 weeks their receptors to the dopamine become altered. With less dopamine received, less pleasure from the same amount of sugar is experienced, thus creating an addiction cycle, as a person must consume more to reach the same level of satisfaction from dopamine release. This is referred to as tolerance.

If a person were to build up sugar tolerance and then quit sugar, they would experience a drop in dopamine, and dopamine receptors would respond in a withdrawal like fashion (Lustig, 2015). A study that compared sugar addiction to cocaine allowed rats to choose between two levers, eight times per day. One lever contained a behaviorally effective dose of cocaine, while the other released a 20-second access to water sweetened with saccharin. Before making their choices, the rats were allowed to sample each lever two times to learn what was in them. All of the rats preferred the sweetened water to the cocaine, and only picked the lever that contained cocaine 15.6% of the time (Lenoir et al., 2007). Though this is animal research, it highlights a potential relationship between cravings and sugar when contrasted to an addictive substance such as cocaine.

### **Depression and physical activity**

One lifestyle change prescribed by health professionals to reduce weight is regular exercise (NIH, 2017), such as seen in the second goal of the Look

AHEAD study. The recommended physical activity for a healthy adult is to engaged in moderate exercise for at least 30 minutes each day. For obese adults the recommendation is to exercise 30-45 minutes a day, 3-5 days a week (NIH, 2017).

The effects of different types of exercise have been studied in relationship to depression. One pilot study found that aerobic exercise, defined as a 10 minute warm up, stretching, and running in 6-minute increments at 65-60% of maximum heart rate for 40-60 minutes, was associated with lower levels of depression. The levels of depression were measured using the Beck Depression Inventory, and were improved by an increase in levels of serotonin resulting from increased exercise (Dimeo et al., 2001).

Another study found similar results regarding aerobic exercise. Researchers divided participants into three groups, one that performed aerobic exercise by briskly walking or jogging for 30 minutes a day for 10 consecutive days, one which stretched for 30 minutes a day for 10 consecutive days, and a control group which did not perform any exercise for 10 days. Depression levels were measured with the Beck Depression Inventory. The results showed that the aerobic exercise group had an average decrease in depressive symptoms of 47.6 percent. Stretching exercise was less successful, but still effective in decreasing depressive symptoms in patients by an average of 24.8% (Legrand & Neff, 2016).

A systematic review was conducted to explain why exercise reduces depressive symptoms (DeBoer et al., 2012). The first theory was the thermogenic hypothesis, which suggests that the body warming up from exercise is the cause of relaxation and release of muscular tension, which decreases depressive symptoms. The second theory was the endorphin hypothesis, which proposed that the exercise induced endorphin release

resulted in an improved sense of well being and a reduction in depression. The monoamine hypothesis was also analyzed, which stated that exercise influences the brain by increasing the availability of neurotransmitters, and dopamine response. While the researchers state it is the most promising of the hypotheses, the relationship between neurotransmitter availability and exercise has not yet been studied in humans. Finally, the distraction hypothesis argued that the reason exercise was beneficial in reducing depressive symptoms because it occupies an individual and distracts them from depressive thoughts.

Although studies have shown the positive effects of exercise on patients with depression, there is research suggesting that exercise alone cannot alter depression and that diet may have a more direct link.

### **Dietary pattern in the U.S.**

According to the 2015-2020 Dietary Guidelines for Americans, the majority of Americans are eating a diet low in fruits, vegetables, dairy, and healthy oils. Additionally, Americans are, overall, exceeding the recommendation for saturated fat, sodium, and added sugar intake (Dietary Guidelines for Americans, 2015).

The recommended amount fruit to be consumed on a 2,000-calorie diet, the average calorie recommendation for an adult woman, is 2 cups per day. American adult females are only consuming an average of 0.8 cups of fruit per day. For vegetables, the recommendation is at 2.5 cups, while American adult females are only consuming 1.4 cups. The recommendation for milk and milk products is 3 cups a day, while Americans are only consuming 2 cups on average (USDA, 2017). Added sugars and solid fats are considered 'discretionary calories' and are low in nutrient density and high in

calories. The average intake of discretionary calories is 923 in men, and 624 in women. Women are consuming up to 4 times their limit in this category (Bliss, 2012).

### **Dietary recommendations and patterns**

It is recommended by the Dietary Guidelines for Americans to consume as little added sugar as possible, the maximum amount being 10 percent of total calories intake per-day. This means that on an average 2,000 calorie diet, a woman should only be eating up to 200 calories of added sugar. Currently, women and men of all ages exceed this recommendation. A CDC data analysis of NHANES 2005-2010 reported added sugar intake in women ages 20 and older. On average, the diet of women age 20-39 consisted of approximately 13.8% added sugar, or 275 calories. For women ages 40-59 the number was 11.8% added sugar, or 236 calories. In 60 and older, women's diets are about 11% added sugar, or 182 calories (Ervin & Ogden, 2013).

Racial and ethnic differences have also been observed. Non-Hispanic black Americans were noted to consume a higher percentage of added sugar compared to non-Hispanic white Americans and Mexican Americans. Non-Hispanic black males consumed 14.5% of their daily calories as added sugar, while non-Hispanic white males and Mexican American males consumed 12.8% and 12.9% respectively. Non-Hispanic black women consumed 15.2% of their daily calories as added sugar, while the number for non-Hispanic white women was non-significantly lower at 13.2%, and even lower for Mexican American women, who consumed 12.6% of their calories from diet as added sugar (CDC, 2014).

### **Added Sugar Definition**

Added sugar is defined as a sugar that is added to a food or beverage and is not naturally occurring in that particular food (USDA, 2016). This also includes sugars that are perceived as 'natural' such as honey, maple syrup, raw sugar, fructose corn syrup, and molasses. As long as the sugar is not found in the particular food or drink in its natural state, it is considered added sugar. Although sugar, which are carbohydrates, do provide calories and can occur naturally in foods, foods that have added sugar typically lack other healthy aspects of the carbohydrate nutrient such as fiber, b-vitamins, and small amounts of protein (Dietary Guidelines for Americans, 2010).

### **Added Sugar**

The average daily caloric intake in the United States for adults older than 19 is 1,785 for women, and 2,640 for men (Dietary Guidelines for Americans, 2010). According to a study examining various national dietary surveys distributed between 1977 and 2012, using administered 24-hour recalls, the rates of added sugar consumption has increased from 119 to 142 calories per day in American adults. That is approximately a 19% increase, over just 35 years (Powell, Smith-Taillie & Popkin, 2016).

The Dietary Guidelines for Americans recommend that adults consume 6 teaspoons, or 10% or less of their calories from added sugars. The USDA 2017 report indicates that only 39% of Americans age 20-49 are at or below the added sugar recommendation. The average added sugar intake is 26.3 teaspoons of added sugar per day, far above the 6 teaspoon or less recommendation. This value adds up to approximately 420 discretionary calories, and may have an association with weight gain (Bowman et al., 2017).

Americans consume added sugar in large amounts through consumption of sugar-sweetened beverages (SSB), which are beverages that use added sugar as sweeteners (Ruanpeng et al., 2017). Researchers have examined the intake of added sugar in the form of high fructose corn syrup and determined that there is a likelihood this form of added sugar, and specifically in the form of SSB, is linked to the obesity epidemic in the United States (Bray, Nielsen, & Popkin, 2004).

A 2006 meta-analysis using research focused on SSB, found that intake of SSB is associated with a greater risk of being overweight and obese in adults (Malik, Schulze, & Hu, 2006). Other common foods that are staples in many American homes are table sugars and syrups such as maple syrup or honey added to foods such as pancakes. Sweets such as candy or chocolate are another common added sugar source, as well as pre-sweetened grains such as sugary cereals and snack foods (Guthrie & Morton, 2000). These foods have also been found to have an association with elevated weight (Bray, Nielsen, & Popkin, 2004).

### **Added sugar intake and Depression**

The average consumption of sugar in the United States is 22 teaspoons per day, which is 60% over the recommended Dietary Guidelines maximum of 12 teaspoons a day on a 2,000-calorie diet (Johnson, Appel, & Brands, 2009). Although the exact amount of sugar an individual needs to eat in order to have an association with depression has yet to be examined, a recent 2015 retrospective cohort study of 87, 617 postmenopausal women found that those who consumed high glycemic index foods and added sugars had a relationship with risk factors for depression. The dietary data was determined by using a 145-item FFQ specifically designed for this study. This FFQ identified the glycemic

index of the foods consumed by of participants, and their added sugar intake.

Depression was measured using the Burnam 8-item scale for depressive disorders. The results show that added sugars, and high GI diets were more strongly associated with depression (Gangwisch et al., 2015).

An international ecological study was conducted examining the possible relationship between sugar consumption and major depression using an existing cross-sectional data set with rates of major depression in various countries (Canada, France, Germany, Korea, New Zealand, and the United States). The sample included approximately 38,000 participants over the age of 18, consisting of 52-66% women (Weissman et al., 1996). Data regarding sugar consumption levels was collected from the Food and Agriculture Organization from 1990-1992. The results indicated an association between the higher the levels of sugar a country consumed, the more cases of depression existed in that country. Though this is an ecological study and many variables could influence the depression rates, it is an interesting point of societal cultures and lifestyle factors related to depression (Westover & Marangell, 2002).

A 2016 study examined different aspects of diets and their link to depression. This study was focusing on the Mediterranean diet examined data from 9,670 participants using data from a separate dataset of the cross-sectional analysis from the Seguimiento Universidad de Navarra prospective cohort study. The researchers discovered that a Mediterranean diet, meaning one full of vegetables and fish and naturally low in added sugar, was linked to the decreased prevalence of depression (Sanchez-Villegas, 2016).

Additional supportive results were reported in a 2012 meta-analysis. The researchers reviewed studies that included nutrition and major depressive

disorder. It was found that the Mediterranean diet and an increased intake of several vitamins and amino acids, was associated with lower levels of depression, while refined carbohydrates and sugars, fast food, and alcohol are linked to higher levels of depression. While more research is needed, studies have shown that an association between nutrition and depression does exist (Popa & Ladea, 2012).

An Australian prospective cohort study focused on Mediterranean diets and mental health. Researchers recruited 13,201 participants between 1990-1994 for the baseline. The age range was 27-76 years of age. Twelve years later, 8,683 of the subjects participated in a follow up. The study was conducted using lifestyle related questionnaires, such as the 10-point anxiety and depression Kessler Psychological Distress Scale, which measures psychological well – being. Dietary data was measured using self-administered 121-item food frequency questionnaire to assess subjects' adherence to a Mediterranean diet. Participants who followed a Mediterranean diet were less likely to report psychological distress compared to those following an Australian diet (Hodge et al., 2012). Most Australians follow a Western diet that is high in empty calories, processed meats, and sugar-sweetened beverages, similar to the United States (Hendrie et al., 2017).

In a meta-analysis of dietary patterns and depression, researchers focused on the diets of community-dwelling adults. Twenty-one studies were analyzed to identify patterns association with depression, and 13 observational studies were used. Some of the studies used food frequency questionnaires for data collection, while others used either one or two, 24-hour dietary recalls. Similar to the previous study, depression was primarily measured using the CES-D. It was found that a healthy diet that includes a high

consumption of fruits, vegetables, fish, and whole grains is associated with lower rates of depression ( $p = 0.001$ ) (Lai et al., 2013).

In a separate 2014 systematic review, researchers reviewed 16 articles that studied the association between diet and depression. The studies used different methods for the dietary data collection, primarily food frequency questionnaires, but also including 24-hour dietary recalls. Levels of depression were measured using various depression scales, most commonly the Center for Epidemiologic Studies - Depression Scale (CES-D). The different diets were divided into the following categories: traditional/healthy, western/unhealthy, and Mediterranean using the data provided by the food frequency questionnaires and 24-hour recalls mentioned above. Like the previous study, this study also found that participants, who followed a Mediterranean diet, as well as a healthy diet, were less likely to suffer from depression, and participants following a western diet were more likely to suffer from depression (Rahe, Unrath, & Berger, 2014).

Various other studies show the dietary benefits of eating more fruits and vegetables on depression. In a large Swiss cohort study, 20,220 participants completed a survey, and the researchers analyzed if they consumed the recommended amount of fruits and vegetables over a 5-day period. This amount was defined as 2 servings of fruit and 3 servings of vegetables. Depression levels were measured by the 5-item mental health index, which can be self-administered and uses 6-point Likert scale responses. Participants who met the recommendation were 11.6% of the low distress group, 9.3% of the moderate distressed group, and 6.2% of the high distress group. These results show that higher fruit and vegetable consumption is associated with lower psychological distress (Richard et al., 2015).

## Depression, Diet, and the Microbiome

The connection between the microbiome and depression, called the gut-brain axis, had gained recent attention in research. Each individual has more than 100 trillion bacterial microbes in their gut, along with archaea, viruses, parasites, or fungi, establishing their gut microbiome (Moschen, Wieser, & Tilg, 2012). There are many factors influencing the diversity of gut microbiome. The types and amounts of microbes present largely depend on the gender, environmental factors, and diet of an individual. In the gut, a diverse microbial community is associated with health, while low diversity is associated with obesity and inflammatory bowel disease (The Human Microbiome Project Consortium, 2012). The foods and beverages an individual consumes directly influences which microbes are present in the gut.

In a study that sought to find the microbes that are associated with different diets, 98 participants provided fecal samples. The participants had different diets, collected by a dietary recall to record recent eating habits, and a food frequency questionnaire, for more long term dietary data. The researchers found that that the bacteria "*Bacteroids*" was prevalent in the gut of participants who consumed more protein and animal fat. *Bacteroidetes* and *Actinobacteria* were plentiful in participants who consumed more fiber, and *Firmicutes* and *Proteobacteria* were abundant in those who consumed little fiber. The bacteria "*Provetella*" was common in participants who consumed high amounts of carbohydrates and simple sugars (Wu et al., 2011).

A separate study examined the brain structure and response differences between women with different types of abundant gut bacteria. Fecal samples were provided by 40 female participants, 33 had a gut abundant in *Bacteroids*, and 7 were abundant

in *Provetella*. The *Provetella* abundant participants reported higher levels of negative feelings after looking at photos with negative images than the participants abundant in *Bacteroids* did (Tillisch et al., 2017). This study adds possible insight to the ways diet influences mental health through the gut microbiome.

The gut microbes have an affect on the way people feel and behave, including levels of depression (Luna & Foster, 2015). Additionally, the gut microbiome of a depressed person is drastically different than the microbiome of a person without depression in richness, diversity, and composition (Kelly et al., 2016). One connection between the gut-brain axis and depression is that 95% of serotonin, an important neurotransmitter relevant to depression, is stored in the gut (Kim & Camilleri, 2001).

Most of the research on this topic been conducted primarily on animals, but has shown to be extremely promising so far (Evrensel & Ceylan, 2015). In a study which combined human and animal research, fecal DNA was collected from 33 healthy participants and 34 participants with depression. The researchers used the samples from the 3 participants with the most severe depression, and 3 of the healthy samples. The samples were transplanted into 13 microbiota-depleted mice that received the DNA of depressed participants, and 15 mice that received the healthy DNA. The mice that received the fecal transplant from the depressed participants developed the inability to feel pleasure, and were physiologically more similar to depressed individuals. Some more recent gut-brain axis studies are only now beginning to be conducted more commonly on humans, but are mostly focusing on Autism Spectrum Behaviors (Knight, 2014).

## Depression Measures

Depression is typically measured by assessing how many of the depressive symptoms listed in the DSM-IV a participant is experiencing. Depression can be assessed by an interview led by a health professional, or by a self-administered test. There are many tools that measure depression by using self-assessment scales, and each focuses on something different. One example is the Correa-Barrick. In addition to screening participants for depression, this test can also be used to measure changes in depression over time to track treatment response, and has a specialized postpartum depression scale option (Barrick, Taylor, & Correa, 2015). Another tool used in a few of the studies mentioned above is the Center for Epidemiologic Studies - Depression Scale (CES-D), which is a 20-item measure that is meant to be completed by a caregiver (Radloff, 1977). The data for particular study is collected using a self-administered survey for all women, not just caregivers, so the CES-D was not a good fit. The tool this study will be using is the Patient Health Questionnaire (PHQ-9), which is also self-administered and can easily be placed into an online survey. The PHQ-9 is a brief screener that contains 9 items, each based on a symptom of depression stated in the DSM-IV. The screen only takes a few minutes to complete, so it is helpful in keeping participant burden as low as possible. The PHQ-9 is unique in that it is a free valid tool and does not require any permission to be used. Due to these advantages, the PHQ-9 has been used in many studies measuring depression, as well as ones similar to this study which measure associations between diet and depression in American adults (Kim, Shin, & Song, 2015).

## **Diet Measures**

Measuring the diet of participants can be a very complex and burdening task for both the data collector and the participant. The method regarded as being the most accurate measure, or gold standard, of dietary data assessment is the dietary recall. This is when the participant is asked to tell the researchers everything they consumed, typically in the previous 24-hour period. A precise 24-hour recall includes exact measurements of each ingredient, cooking methods of each item, as well as condiments added to meals. The most accurate way for a 24-hour recall to represent the diet of a participant, is to conduct multiple recalls over the course of a week or two, taking into account weekends and other regular occurrences that may lead to dietary changes (Biró et al., 2002). Each recall can take about 45-60 minutes.

Another option to measure diet is a food log, typically kept by the participant. In a food log, the participant journals everything he or she consumed in a set amount of time. Food logs are not as accurate as dietary recalls because they are typically less detailed and have increased participant error. Their validity is deemed satisfactory with proper training (Kavetti & Knuts, 1992).

An additional method to measure diet is the use of the food frequency questionnaire (FFQ), which is a scale measuring how often a participant consumed a specific food item over the course of a decided amount of time. FFQ's can range from 20 to over 100 items. A commonly used FFQ is the Block Fat/Sugar/Fruit/Vegetable Screener, which contains 55 items and includes levels of added sugar consumption in the analysis. This FFQ takes about 10-12 minutes to complete, and can be self-administered, making it a good option for online data collection.

There are a few types of Block Food Frequency Questionnaires, which are considered valid and reliable measures of diet. In a study comparing three major FFQ's, the Block, Willett, and National Cancer Institute FFQ, the Block test was shown to be one of the better methods of estimating absolute intake (Subar et al., 2001). In another study, the validity and reliability of the Block FFQ was assessed in the context of measuring the diet of adult women. Participants completed both dietary recalls and the Block FFQ. The results showed the FFQ validity and reliability to be moderate to high, supporting its future usage (Boucher et al., 2006).

### **Dietary Recommendations for MDD**

Currently there are no official dietary change recommendations for patients with depression. One case study focusing on the impact of specific dietary recommendations for depression involved a 34-year-old woman with major depression (Yeoh, 2016). Seeking to improve her condition, she followed specific diet and lifestyle changes. She was instructed to eliminate gluten, dairy, sugar, and alcohol from her diet and replace her morning coffee with tea. After just one month, she reported much lower levels of depression. After three months of following these changes, the participant was taken off of anti-depressants by her psychiatrist. One year later, her depression symptoms had not returned. Though a mere case study, it brings up a good point that modification may have an impact on mental health just as it does on the risks of obesity and disease risk. Additionally, upon diagnosis of depression, it is not standard for a medical practitioner to prescribe specific dietary recommendations along with other treatments. A study examined the various lifestyle change recommendations made by doctors to treat depression. The active treatment group was assigned specific dietary guidelines, and the control group was instead instructed to "try to eat a healthy and balanced diet". The active treatment group received specific dietary instructions to not to snack between

meals or consume sugary drinks, eat fish at least three times per week, and increase nut, cereal, fruit, and vegetable to daily intake. The group that received more clear and specific instructions for a healthier diet showed a decline in rates of depression (Ripoll et al., 2015).

## Chapter 3

### Methodology

#### **Study Design**

This study was a cross-sectional observational study. Characteristics of American women between the ages 18-55 were observed through the collection of a survey, which

included a depression scale and an FFQ. The Institutional Review Board at San Francisco State University approved the exempt protocol for this study (April, 2017). Study participants were provided an Implied Consent to Participate in Research at the beginning of the survey and participants were given the option to participate or not. There were no risks, benefits, or penalties for survey participants.

### **Sample Size and Power Analysis**

The sample size was calculated on the 8.5% national prevalence of MDD in women (National Institute of Mental Health, 2015). At a 90 % confidence level and a 5% confidence interval (margin of error) the calculated minimum sample size needed was 50 subjects.

### **Recruitment**

Participants were recruited from a convenience sample using the personal Facebook profile of the researcher, the profiles of those who shared the survey on their Facebook, Facebook groups targeting support for depression, and families belonging to Congregation Beth Am religious school in Los Altos Hills, California. The researcher delivered a brief speech (Appendix 1: Recruitment script for Facebook support group pages, Appendix 2: Recruitment script for Facebook personal page and congregation) in English to recruit the participants. Participants were not required to participate. The survey sample included female participants ages 18-55 who had computer and internet access and a Facebook account, or were emailed the survey by the Jewish religious school their child attended. The participants were English speaking, and primarily White.

### **Inclusion Criteria**

The inclusion criterion for this study were, participants needed to be female between the ages 18-55 and be able to read and write in English.

### **Enrollment**

Two-hundred surveys were returned and 125 were excluded due to incomplete data (participants not completing the FFQ), or insufficient funds to cover NutritionQuest analyses for over 75 participants. One survey was excluded due to an unrealistic BMI report of 10%. A BMI under 18.5% is considered underweight, and a BMI of 10% would result in death. Seventy-four surveys were used in the data analysis.

### **Measurement Instruments**

The survey was administered using Qualtrics, software specializing in digital data collection and analysis. The survey was developed from existing validated questionnaires determining levels of depression and eating behaviors, and included demographic, knowledge, depression scale, and FFQ survey questions to American women between the ages of 18-55. The survey was distributed on the researcher's Facebook on a Thursday at 1:00pm and on a Monday at 10:00pm. It was distributed on Facebook groups for depression support on a Thursday at 1:00pm, and was distributed to Congregation Beth Am religious school families on a Monday at 4:00pm.

(Appendix 4: Survey). Assessment and analysis for the FFQ was conducted by NutritionQuest, the company which owns it, and includes the average amount of added sugar (in grams) consumed by each participant daily.

In addition to the behavioral questions, the survey asked for ethnicity, participant's self reported height and weight, and if the participant was pregnant or breastfeeding at the time of the survey. NutritionQuest then calculated body mass index

(BMI). The survey also included 4 multiple choice knowledge questions about how much added sugar the following foods include: apple, carrot, strawberry yogurt, and a 12oz can of cola. Additionally, there was a yes or no question asking if the participant was in a better mood when she ate healthier, and another asking if the participant was in a worse mood when she ate a less healthy diet. Lastly, there was a question asking if the participant received specific nutritional advice if she has ever consulted a health professional regarding depression.

### **Statistical Analysis**

Statistical Package for the Social Sciences (SPSS) software version 24 and RStudio software version 3.3.2, 2016 were used to perform the data analysis. Assumptions for normal distribution were tested. Most correlations were tested using Pearson's correlation, which is based on five assumptions: that all variables are continuous, that each observation has a pair of values, that there are no outliers in the data, the normality of the variables, linearity and homoscedasticity. Two correlations were tested using the Spearman correlation. Assumptions for the Spearman correlation are that the data must be interval, ordinal, or ratio level.

## **Chapter 4**

### **Results**

#### **Participant Demographic Characteristics**

Participant demographic characteristics are shown in Table 1. A total of 74 participants' data were analyzed, 100% of which (n=74) were female as per the inclusion criteria. Across all participants, 45 (60.8%) were between the ages of 18-37, and 29

(39.2%) were between the ages of 38-55 (Table 1). Ethnicities of participants included White (n=61), Latino (n=1), Asian (n=3), Native American (n=1), and multiple ethnicities (n=4) (Table 1).

Table 1  
*Demographic Characteristics of Participants (n=74)*

Variable	f	%
Gender		
Male	0	0.0
Female	74	100.0
Other	0	0.0
Total	74	100.0
Age		
18-22	13	17.6
23-27	17	23.0
28-32	10	13.5
33-37	5	6.8
38-42	6	8.1
43-47	6	8.1
48-52	11	14.9
53+	6	8.1
Total	74	100.0

Table 1  
(Continued)

Ethnicity		
White	61	82.4
Latino	1	1.4
Asian	3	4.1
Native American	1	1.4
Multiple Ethnicities	4	5.4
Undeclared	4	5.4

Total	74	100.0
-------	----	-------

Participants' self-reported current height (inches) and body weight (pounds) status. Using that information, participant BMI scores were calculated using the formula: weight in kilograms divided by height in meters squared (reference this formula using this NIH website [https://www.nhlbi.nih.gov/health/educational/lose\\_wt/BMI/bmicalc.htm](https://www.nhlbi.nih.gov/health/educational/lose_wt/BMI/bmicalc.htm)). Participant BMI scores were calculated by NutritionQuest as part of the FFQ data analysis provided by them (reference NutritionQuest here) (Table 2).

The mode BMI was the "normal weight" category (59.5%), however the raw score mean was  $25.3 \pm 5.7$ , which is in the "overweight" category (Table 2). According to the BMI scores of the participants ( $n=74$ ), 2.7% were "underweight", 21.6% were "overweight", and 16.2% were "obese" (Table 2).

Table 2  
*Participant BMI (n=74)*

BMI	<i>f</i>	%	<i>Mean</i>
			25.3
Underweight (18.4 and below)	2	2.7	
Normal weight (18.5 - 24.9)	44	59.5	
Overweight (25.0 - 29.9)	16	21.6	
Obese (30.0 and above)	12	16.2	
Total	74	100.0	

#### **Added Sugar Knowledge Questions**

The survey for this study included 4 questions assessing participant knowledge of added sugar questions which asked participants to estimate how much added sugar was in the following food items: a carrot, an apple, strawberry yogurt, and a 12-ounce can of cola (Appendix 4: Survey). Answer options were provided in multiple-choice format in grams, with the following options: 0g, 9g, 18g, 39g, 49g.

Participant results were grouped into 3 categories (Table 3): 48.6 received a “low score”, which meant participants answered 0 or 1 question correctly. Participants who scored 2 or 3 questions correctly received a “medium score”, which made up 41.9% of the sample. A “high score” was assigned those who answered all 4 questions correctly, which was 9.5% of the sample.

Table 3  
*Added Sugar Knowledge (n=74)*

Variable	<i>f</i>	%
Categorical Score (4 Questions)		
Low Score (0-1 Correct)	36	48.6
Medium Score (2-3 Correct)	31	41.9
High Score (4 Correct)	7	9.5
Total	74	100.0

### **Participant Reported Depression**

The PHQ-9 raw scores were analyzed to result in 5 possible categories (Table 4). Of the participants, 48% (n=36) received a “normal” score of 0-4, meaning they showed no signs of depression. Participants in the “minimal” category scored 5-9, meaning they showed minimal signs of depression, 29.7% (n=22) of the participants scored in this category. Participants with a raw score of 10-14 were categorized as having “mild” depression, and included 13.5% (n=10) of participants. Participants in the

“moderate” category received a raw score of 15-19, 2.7% (n=2) of participants scored in this category. Participants who received a raw score of 20 or above were categorized as having “severe” depression, which included 5.4% (n=4) of participants (Table 4).

Table 4

*Participants' Depression Category Based on PHQ-9 Score (n=74)*

Variable	<i>f</i>	%
Normal 0-4	36	48.6
Minimal 5-9	22	29.7
Mild 10-14	10	13.5
Moderate 15-19	2	2.7
Severe 20+	4	5.4
Total	74	100.0

**Participant Added Sugar Intake**

Average daily added sugar intake was measured by the FFQ the participants completed, and NutritionQuest provided the results in grams (Table 5). The Dietary Guidelines for Americans recommended consuming no more than 6 teaspoons, or about 24 grams of added sugar daily (Dietary Guidelines for Americans, 2015). In this study (n=74), 39.2% (n=29) of the participants reported added sugar intake that was within the USDA recommendation, and 60.8% (n=45) exceeded the recommended intake. Approximately one-third of the participants (32.4%, n=24) at least doubled the recommended added sugar intake. The mean added sugar intake was 40.62 ± 30.9 grams (Table 5).

Table 5

*Participants' Added Sugar Intake in Grams (n=74)*

Variable	<i>f</i>	%	<i>Mean</i>
Daily Sugar Intake (Grams)			40.62

0-9.99	9	12.2
10-19.99	14	18.9
20-29.99	11	14.9
30-39.99	8	10.8
40-49.99	8	10.8
50-59.99	6	8.1
60-69.99	7	9.5
70-79.99	4	5.4
80-89.99	2	2.7
90-99.99	2	2.7
100+	3	4.1
<b>Total</b>	<b>74</b>	<b>100.0</b>

### **Participant Sugar Intake and Depression Levels**

The main focus of this study was to examine the association between added sugar and major depression. From the PHQ-9 and FFQ data collected (n=74), 65.5% (n=19) of the participants that scored “normal” depression levels, meaning they did not show symptoms of depression, were calculated to be meeting or below the recommended added sugar intake of below 25g (Table 6). Of the participants who scored above normal on the PHQ-9, showing minimal to severe depression, 34.5% (n=10) met or were below the added sugar recommendation, and 62.2% (n=28) were above the recommendation. Alternatively, only 37.8% (n=17) of the participants who scored “normal” on the PHQ-9 were above the added sugar recommendation.

A Pearson Correlation analysis was run using the depression category scores and the added sugar intake data, establishing significance at  $r=.389$ ,  $p < .05$ . The resulting  $p$  value was .001 (Table 6), meaning there is a .1% chance the variables are not associated.

Table 6

*Pearson Correlation Analysis of Participants' Daily Added Sugar Intake Above Recommended 25 Grams by the American Heart Association and PHQ-9 Results Above Normal (n=74)*

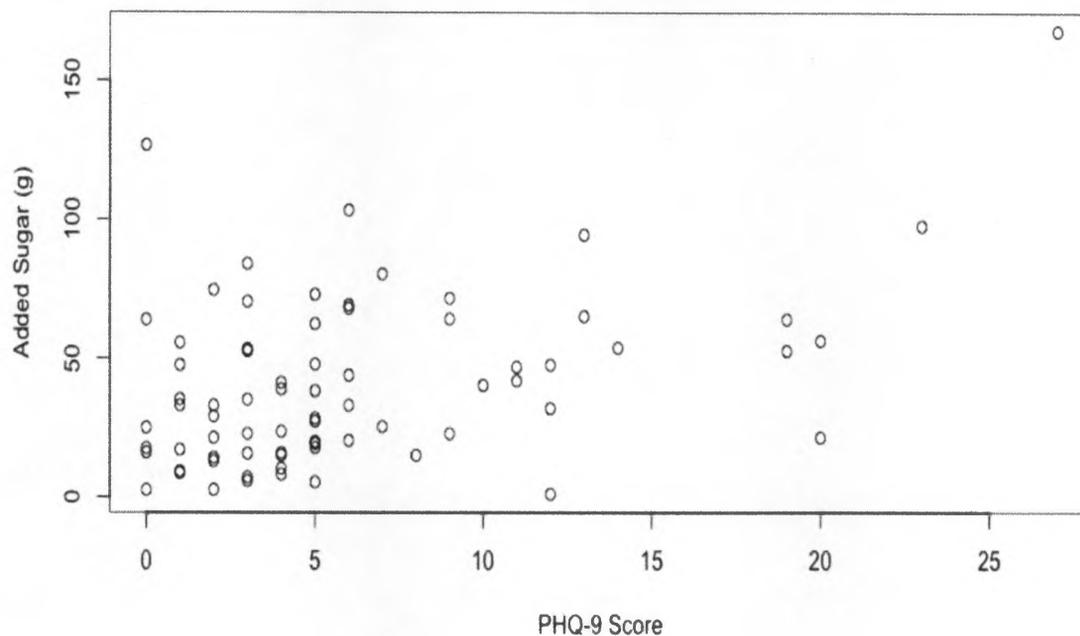
Variable	<i>Reported Added Sugar Intake</i>				<i>p</i>
	<u>Meeting or Below</u>		<u>Above</u>		
	<u>Recommended 25g</u>		<u>Recommended 25g</u>		
	<i>f</i>	<i>%</i>	<i>f</i>	<i>%</i>	
PHQ-9 Result					.001*
Normal	19	65.5	17	37.8	
Above Normal	10	34.5	28	62.2	
Total	29	100.0	45	100.0	

\* Correlation is significant at the 0.05 level (2-tailed)

A scatterplot below shows the raw participant PHQ-9 scores compared to the levels of added sugar in grams (Table 7). In the scatterplot, it is possible to visualize the majority of the participants, which scored “normal” on their PHQ-9, which included raw scores up to 4 (refer to Table 4). It is also possible to see that of the participants who scored “moderate” (n=2) and severe (n=4) PHQ-9 scores, only one participant was not clearly above the recommended added sugar intake (Table 7).

Table 7

### Scatterplot of Participant PHQ-9 Raw Score Compared to Added Sugar Intake in Grams

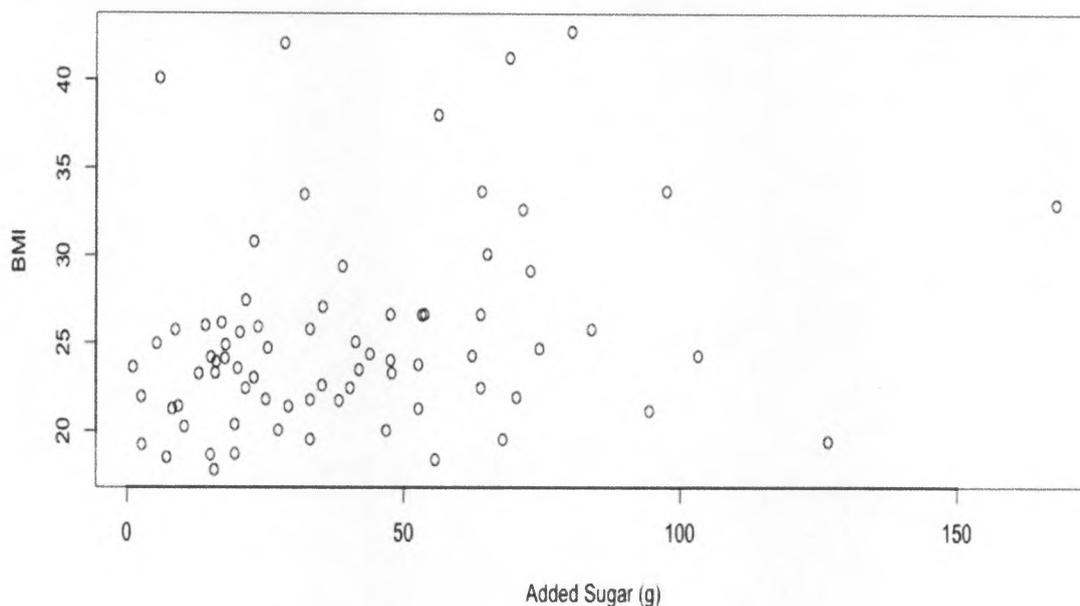


### Participant BMI Category and Added Sugar Intake

The Spearman's Correlation was calculated between levels of added sugar in grams that the participants consumed, and their BMI category. The result was a significant  $r = .249$ ,  $p = .032$  set at  $p > .05$  significance. This means that participants who consumed higher levels of added sugar were significantly more likely to have a higher BMI (Table 8).

Table 8

**Scatterplot of Participant Added Sugar Intake in Grams Compared to BMI**



### **Participant BMI Category and Nutrition Advice**

Of the participants in this study ( $n=74$ ), 17.5% ( $n=13$ ) of participants have received nutritional advice when consulting a healthcare professional for depression treatment, and 36.5% ( $n=27$ ) have not. To test for an association between the BMI of participants and if they received nutrition, a Spearman's Correlation was run at a 95% confidence interval. The results were a significant correlation,  $r = -.238$ ,  $p = .041$ , meaning that the higher participants' BMI was, the less likely they were to receive nutritional advice from a health professional when being consulted regarding depression.

None of the participants who were in the "underweight" BMI category received nutritional advice from a health professional ( $n=0$ ). In the both the "normal weight" group as well as the "overweight" group, 6.8% ( $n=5$ ) of participants received nutritional advice from a health professional. Of the participants in the "obese" category, 4.1%

(n=3) participants received nutritional advice from a health professional. In all of these BMI category groups, the number of participants who did not receive nutritional advice was higher than the number of participants who did (n=1, n=15, n=6, and n=5 respectively).

Table 9  
Participant BMI Compared to Professional Nutritional Advice Received (n=74)

Variable	Professional Nutritional Advice Received						p
	Yes		No		Not Applicable		
	f	%	f	%	f	%	
BMI							.041*
Underweight (18.4 and below)	0	0.0	1	1.4	2	2.7	
Normal weight (18.5 - 24.9)	5	6.8	15	20.3	23	31.1	
Overweight (25.0 - 29.9)	5	6.8	6	8.1	5	6.8	
Obese (30.0 and above)	3	4.1	5	6.8	4	5.4	
Total	13	17.6	27	36.5	34	45.9	

\* Correlation is significant at the 0.05 level (2-tailed)

## Chapter 5

### Discussion

The main hypothesis of this study was that there is an association between added sugar consumption and Major Depressive Disorder (MDD) in women ages 18-55 in the United States. The results of this pilot study support this hypothesis and therefore support the conclusion that an association may exist between added sugar and Major Depressive Disorder (MDD) in women ages 18-55 studied through this pilot study of San Francisco Bay Area women. This pilot study also identified that women who consumed higher levels of added sugar, as determined by the Block Fat/Sugar/Fruit/Vegetable Screener were more likely to self-report higher levels of depression (Results Table 6).

The current U.S. population rate of women experiencing MDD is 7.6%. In this pilot study, 51.4% of the participants reported minimal to severe MDD. One reason for the discrepancy in representation could be the recruitment that took place on social media depression support groups. Another possibility is that the populations of women who complete surveys on social media are more likely to be depressed. A study supporting this theory in 1,787 19-32 year old women, found that the amount of time and frequency participants spent on social media related to the rates of depression, specifically those in the highest quartile reported highest depression compared to those in the lowest quartile for social media usage,  $p < 0.001$  (Lin et al., 2016).

#### **Added Sugar Intake**

In the United States, the average daily sugar consumption is 22 teaspoons per day, or 92.4 grams, while the recommendations is no more than 6 teaspoons, or 24 grams per day (Dietary Guidelines for Americans, 2015). In this pilot study, the average added

sugar intake was 40.62 grams, or about 10 teaspoons. Although participants in this study consumed less than half of the U.S. average, they were still notably above the dietary recommendation.

There are several possibilities explaining the reason this sample was below the national average in sugar intake but higher in depression self-reported scale. One potential reason is socioeconomic status. The survey collecting data for this study was distributed largely through the researcher's Facebook account, which consists primarily of connections living in the San Francisco Bay Area, which is currently the most expensive area for housing in the United States (Renzulli, 2016). Although the survey did not collect any data regarding the socioeconomic statuses of participants, it may be the case that this sample primarily included participants that are more affluent than the general U.S. population. A cross-sectional study that used the US National Health Interview Survey Cancer Control Supplement survey in 2005 to measure added sugar intake and demographics in 28,948 participants found that added sugar intake levels were inversely related to socioeconomic status among both genders. This means men and women in lower socioeconomic statuses were more likely to consume higher levels of added sugar (Thompson et al., 2005).

### **Nutrition Knowledge**

The results of this pilot study found that only seven out of 74 participants could accurately estimate how much added sugar was in an apple, carrot, strawberry yogurt, and a 12 fluid ounce can of regular cola. Additionally, at least 36 of the participants answered that either apples or carrots have 9 or more calories of added sugar, demonstrating a lack of understanding between added sugar and natural sugar. This

observed lack of understanding could result in negative health consequences, particularly if a health professional advises a patient to limit added sugar for medical reasons or weight loss, but the patient does not understand what this means nutritionally.

Overall, Americans are not proficient when it comes to reading the food label. A study examining health literacy in the U.S. recruited 103 participants ages 18-29, and collected health literacy information through Newest Vital Sign Scale (NVS), which is a 6-item questionnaire that uses an ice cream container to assess food label literacy. Scores of the NVS are grouped into 0-2 low (inadequate), 3-4 medium (limited), and 5-6 high (adequate) health literacy. The results showed that female participants scored an average of about 4, or limited health literacy. Results also showed that health literacy predicted positive diet quality in participants, indicating that promoting health literacy may improve diet quality (Cha et al., 2014).

Having access to nutrition information regarding fresh foods, detailed food labels about packaged foods, and knowing how to interpret them can make a difference on levels of added sugar consumption in one's diet. A study that examined the effectiveness of food labels in reducing added sugar collected data from 5,765 participants age 20 and older. The data of these participants were part of a larger dataset collected by the USDA for the 1994–96 Continuing Survey of Food Intakes by Individuals. The results showed a significant relationship between frequent reference to food labels for sugar information, and reduced added sugar intake (Weaver & Finke, 2003).

Recently, the U.S. Food and Drug Administration announced the mandatory addition of added sugar in grams to all food labels (U.S. Food and Drug Administration, 2017). This may have an impact on health and make it possible for those who use the

food labels to track added sugar more accurately. Until this food label change, natural and added sugars in grams were combined on the food label, and it was only possible to estimate amount of added sugar based on how high up they were placed on the list of ingredients, which was not precise.

### **Nutritional Advice for Participants Who Sought Professional Depression Help**

The participants in this study who reported not receiving specific nutritional advice from a health professional upon seeking depression treatment were more likely to have a higher BMI (Table 9). Furthermore, participants seeking any sort of professional treatment for depression were more likely to not receive specific nutrition advice than to receive it. It was up to the participants' interpretation on how "specific nutrition advice" was defined, however, it is not common practice to utilize nutrition in depression treatment. Knüpple et al. (2017) suggest limiting added sugar to treat MDD, and there may be other areas in a diet that may help with prevention of treatment of MDD that have yet to be explored.

The benefits of specific nutrition advice align with the results of Ripoll et al. (2006), which showed improvement in depression levels after receiving specific nutrition and physical activity recommendations. It may seem to health professionals as though instructing the public to "maintain a healthy diet" is sufficient and clear, however the results of the knowledge questions in this study, as well as the higher BMI associated with participants not receiving specific instructions, suggest that each person may interpret those instructions differently depending on their nutrition knowledge.

### **BMI and Added Sugar**

In this pilot study, participant BMI had a significant but weak positive correlation with added sugar intake. A reason the correlation in this study was not a strong between BMI and sugar intake may be that the San Francisco Bay Area is overall health conscious region of the country. Interestingly, similar results were observed in the Minnesota Heart Study, a longitudinal study of approximately 5,000 participants between the ages of 25 and 74 from 1980–1982 to 2007–2009. This study used dietary recalls and examined the relationship between sugar and BMI. It was observed that over the 27-year period, the women studied increased added sugar by 54%, and their BMI increased aligned with a  $P < .001$ .

### **Diet and Mood**

Participants were asked to respond to two questions regarding diet and mood. The first question stated, "do you perceive your mood being better when your diet is healthier?" to which 82.4% (n=61) of the participants responded "yes", and 17.6% (n=13) of the participants responded "no". The second question stated, "do you perceive your mood being worse when your diet is less healthy?", to which 71.6% (n=53) participants responded "yes", and 28.4% (n=21) participants responded "no". This is an interesting observation as though many did not score well on the added sugar knowledge portion of the survey; there was a self-perception of feeling better when eating "healthier".

One aspect of a diet largely considered a "healthy diet" is plentiful consumption of fruit and vegetables, and it is likely that when participants recalled their mood after eating a healthy meal, that meal included fruits and vegetables. As seen in a study by Conner et al. (2014), 405 participants were assessed for fruit and vegetable consumption and mood. Data was collected using an online food diary for 13 consecutive days. The

researchers found that higher fruit and vegetable consumption was associated with greater levels of well-being, curiosity, and creativity.

### **Implications**

The implications of this study are that added sugar consumption may be associated with major depression in the population under study, and that the role of mental health professionals could benefit from this finding. Health professionals could include a referral to a registered dietitian nutritional to learn more about diet, specifically added sugars, or even provide a pamphlet about added sugar in food on the spot. This holistic approach to improving mental health through dietary modification could impact the more severe treatment approaches such as medication or long term treatments, which which often cause side effects that range anywhere from mildly unpleasant, to severe and lead to suicide (Harvard Health Publishing, 2014).

Another way to use the findings from this study are to advocate for nutrition education in the public setting through school based education programs. Providing education about the effects of added sugars on mood and health, and also how to identify what foods have added sugars by using a food label could be a key point in increasing the populations self-efficacy with diet related changes related to mood. Additionally, providing education about the USDA recommendations for daily added sugar intake would be more educational than current public health messages which vaguely state to "eat less sugar".

A proverb dating back to the 18<sup>th</sup> century states "prevention is better than cure" (Speake, 2015), and educating children and young adults on how to stay healthy

physically and mentally through dietary changes could potentially reduce the high added sugar intake and high levels of major depression in the United States.

### **Limitations**

The limitations of this pilot study include a small sample size, convenience sample, and pre-tested only knowledge questions. Additionally, the study collected data using an anonymous self-reported online survey, which allows room for participants to not answer seriously, and misinterpret the questions. This is especially relevant in the PHQ-9, which includes the potentially sensitive and difficult topic of depression. Another limitation associated with the online nature of this survey, was that it did not include participants without internet access. Furthermore, the recruiting occurred largely through the researcher's personal Facebook account, which limited the representativeness of the sample.

Although this study was shared with and open to all ethnicities, another limitation was that 81% (n=60) of the participants reported being White. This does not represent the diversity of the community in which most of the participants live. Lastly, the age range for this study was 18-55, and while participants across the whole age spectrum were recruited, there were fewer participants between the ages of 33-47 than most other age groups.

### **Future Research and Conclusion**

With the current rates of MDD in women in the U.S., it is worthwhile to examine the association between diet and mental health. Though the results of this study were significant in the association between added sugar and MDD, it would be informative to conduct a similar study on a much larger scale to confirm the results with a larger and

more representative sample. It may also be valuable to examine other aspects of diet and mental health, such as current trend diets like Whole30, the Paleo Diet, and the gluten free diet. Although it is unlikely that diet and depression have a purely causal relationship, diet modification has the potential to be a relatively inexpensive and accessible complementary aspect of prevention and treatment of mental illness.

## References

- Adult Obesity Facts. (2016, September 01). Retrieved April 12, 2017, from <https://www.cdc.gov/obesity/data/adult.html>
- Albert, P. (2015). Why is depression more prevalent in women? *Journal of Psychiatry & Neuroscience, 40*(4), 219-221. doi:10.1503/jpn.150205
- Allen, P. J., Batra, P., Geiger, B. M., Wommack, T., Gilhooly, C., & Pothos, E. N. (2012). Rationale and consequences of reclassifying obesity as an addictive disorder: Neurobiology, food environment and social policy perspectives. *Physiology & Behavior, 107*(1), 126-137. doi:10.1016/j.physbeh.2012.05.005
- Avena, N. M., Rada, P., & Hoebel, B. G. (2008). Evidence for sugar addiction: Behavioral and neurochemical effects of intermittent, excessive sugar intake. *Neuroscience & Biobehavioral Reviews, 32*(1), 20-39. doi:10.1016/j.neubiorev.2007.04.019
- Barrick, C. B., Taylor, D. E., & Correa, E. I. (2015). Correa-Barrick Depression Rating  
Becker, E. S., Margraf, J., Türke, V., Soeder, U., & Neumer, S. (2001). Obesity and mental illness in a representative sample of young women. *International Journal of Obesity, 25*. doi:10.1038/sj.ijo.0801688
- Biró, G., Hulshof, K. F., Ovesen, L., & Cruz, J. A. (2002). Selection of methodology to assess food intake. *European Journal of Clinical Nutrition, 56*(S2), S25-S32. doi:10.1038/sj.ejcn.1601426
- Bliss, R. M. (2012, March 12). Snacking Associated with Increased Calories, Decreased Nutrients. Retrieved October 11, 2017, from <https://www.ars.usda.gov/news-events/news/research-news/2012/snackingassociated-with-increased-calories-decreasednutrients/>
- Boucher, B., Cotterchio, M., Kreiger, N., Nadalin, V., Block, T., & Block, G. (2006). Validity and reliability of the Block98 food-frequency questionnaire in a sample of Canadian women. *Public Health Nutrition, 9*(01). doi:10.1079/phn2005763
- Evrensel, A., & Ceylan, M. E. (2015). The Gut-Brain Axis: The Missing Link in Depression. *Clinical Psychopharmacology and Neuroscience, 13*(3), 239-244. doi:10.9758/cpn.2015.13.3.239

- Bowman, S. A., PhD, Clemens, J. C., MS, Marin, C. L., MS, RD, BS, J. A., Steinfeldt, L. C., MPH, & Moshfegh, A. J., MS, RD. (2017, May). Food Patterns Equivalents Intakes by Americans: WWEIA ... Retrieved September 6, 2017, from [https://www.ars.usda.gov/ARUserFiles/80400530/pdf/DBrief/17\\_Food\\_patterns\\_Equivalents\\_0304\\_1314.pdf](https://www.ars.usda.gov/ARUserFiles/80400530/pdf/DBrief/17_Food_patterns_Equivalents_0304_1314.pdf)
- Bowman, S. A., PhD, Clemens, J. C., MS, Martin, C. L., MS, RD, Anand, J., BS, Steinfeldt, L. C., MPH, & Moshfegh, A. J., MS, RD. (2017, May). Added Sugars Intake of Americans: What We Eat in America ... Retrieved September 5, 2017, from [https://www.ars.usda.gov/ARUserFiles/80400530/pdf/DBrief/18\\_Added\\_Sugars\\_Intake\\_of\\_Americans\\_2013-2014.pdf](https://www.ars.usda.gov/ARUserFiles/80400530/pdf/DBrief/18_Added_Sugars_Intake_of_Americans_2013-2014.pdf)
- Bray, G. A., Nielsen, S. J., & Popkin, B. M. (2004). Consumption of high-fructose corn syrup in beverages may play a role in the epidemic of obesity. *American Society for Clinical Nutrition*, 79(4), 537-543.
- Burke, L. E., Wang, J., & Sevick, M. A. (2011). Self-monitoring in weight loss: a systematic review of the literature. *Journal of the American Dietetic Association*, 111(1), 92-102.
- Carpenter, K. M., PhD, Hasin, D. S., PhD, Allison, D. B., PhD, & Faith, M. S., PhD. (2000). Relationships between obesity and DSM-IV major depressive disorder, suicide ideation, and suicide attempts: results from a general population study. *American Journal of Public Health*, 90(2), 251-257. doi:10.2105/ajph.90.2.251
- CDC. (2010, October 01). Morbidity and Mortality Weekly Report (MMWR). Retrieved August 14, 2017, from <https://www.cdc.gov/mmwr/preview/mmwrhtml/mm5938a2.htm>
- CDC. (2013, October 04). Depression. Retrieved August 14, 2017, from [https://www.cdc.gov/mentalhealth/data\\_stats/depression.htm](https://www.cdc.gov/mentalhealth/data_stats/depression.htm)
- CDC. (2017, April 07). Nutrition. Retrieved October 11, 2017, from [https://www.cdc.gov/nutrition/data-statistics/sugar-sweetened-beverages\\_intake.html](https://www.cdc.gov/nutrition/data-statistics/sugar-sweetened-beverages_intake.html)
- Overweight & Obesity. (2017, August 29). Retrieved November 29, 2017, from <https://www.cdc.gov/obesity/data/adult.html>

- Cha, E., PhD, MPH, MSN, RN, Assistant Professor, Kim, K. H., PhD, Associate Professor, Lerner, H. M., Undergrad Research Assistant, Dawkins, C. R., MS, RN, RD, Graduate Research Assistant, Bello, M. K., BS, Graduate Research Assistant, Umpierrez, G., MD, Professor, & Dunbar, S. B., DSN, RN, FAAN, FAHA, Professor. (2014). Health Literacy, Self-efficacy, Food Label Use, and Diet in Young Adults. *American Journal of Health Behavior*, 38(3), 331-339. doi:10.5993/AJHB.38.3.2
- Conner, T. S., Brookie, K. L., Richardson, A. C., & Polak, M. A. (2014). On carrots and curiosity: Eating fruit and vegetables is associated with greater flourishing in daily life. *British Journal of Health Psychology*, 20(2), 413-427. doi:10.1111/bjhp.12113
- Craft, L. L., & Perna, F. M. (2004). The Benefits of Exercise for the Clinically Depressed. *The Primary Care Companion to The Journal of Clinical Psychiatry*, 06(03), 104-111. doi:10.4088/pcc.v06n0301
- Curtin, S. C., Warner, M., & Hedegaard, H. (2016, April 22). Increase in Suicide in the United States, 1999–2014. Retrieved April 04, 2017, from <https://www.cdc.gov/nchs/products/databriefs/db241.htm>
- Deboer, L. B., Powers, M. B., Utschig, A. C., Otto, M. W., & Smits, J. A. (2012). Exploring exercise as an avenue for the treatment of anxiety disorders. *Expert Review of Neurotherapeutics*, 12(8), 1011-1022. doi:10.1586/ern.12.73
- Depression and Suicide. (2017, June 6). Retrieved August 14, 2017, from <https://caps.ucsc.edu/resources/depression.html#suicide-possible>
- Depression In Women. (2016, April 27). Retrieved October 10, 2017, from <http://www.mentalhealthamerica.net/conditions/depression-women>
- Dhingra, S. S., Kroenke, K., Zack, M. M., Strine, T. W., & Balluz, L. S. (2011). PHQ-8 Days: a measurement option for DSM-5 Major Depressive Disorder (MDD) severity. *Population Health Metrics*, 9(1). doi:10.1186/1478-7954-9-11
- Dietary Guidelines 2010. (n.d.). Retrieved April 12, 2017, from <https://health.gov/dietaryguidelines/2010/>
- Dietary Guidelines for Americans 2015–2020 8th Edition. (n.d.). Retrieved April 12, 2017, from <https://health.gov/dietaryguidelines/2015/guidelines/>

- Dimeo, F., Bauer, M., Varahram, I., Proest, G., & Halter, U. (2001). Benefits from aerobic exercise in patients with major depression: a pilot study. *British Journal of Sports Medicine*, 35(2). <http://dx.doi.org/10.1136/bjism.35.2.114>
- Dinn, A. A., & Caldwell-Harris, C. L. (2016). How Collectivism And Family Control Influence Depressive Symptoms In Asian American And European American College Students. *Elektronik Sosyal Bilimler Dergisi*, 15(57). doi:10.17755/esosder.44308
- Disease Control and Prevention (2013). NCHS Data Brief, No. 122: Consumption of Added Sugars Among U.S. Adults, 2005–2010. Retrieved from <http://www.cdc.gov/nchs/data/databriefs/db122.pdf>
- Duldulao, A. A., Takeuchi, D., & Hong, S. (2009). Correlates of Suicidal Behaviors Among Asian Americans. *Archives of Suicide Research*, 13(3), 277-290. doi:10.1080/13811110903044567
- Ervin, R., Ph.D., R.D., & Ogden, C. L., Ph.D., M.R.P. (2013, May). Consumption of Added Sugars Among U.S. Adults, 2005–2010. Retrieved from <https://www.cdc.gov/nchs/data/databriefs/db122.pdf>
- Gómez-Pinilla, F. (2008). Brain foods: the effects of nutrients on brain function. *Nature Reviews Neuroscience*, 9(7), 568-578. doi:10.1038/nrn2421
- Gupta, A., Mayer, E. A., Hamadani, K., Bhatt, R., Fling, C., Alaverdyan, M., . . . Labus, J. S. (2017). Sex differences in the influence of body mass index on anatomical architecture of brain networks. *International Journal of Obesity*, 41(8), 1185-1195. doi:10.1038/ijo.2017.86
- Harris, A. H., Cronkite, R., & Moos, R. (2006). Physical activity, exercise coping, and depression in a 10-year cohort study of depressed patients. *Journal of Affective Disorders*, 93(1-3), 79-85. doi:<http://doi.org/jpllnet.sfsu.edu/10.1016/j.jad.2006.02.013>
- Harvard Health Publishing. (2014, March). What are the real risks of antidepressants? Retrieved November 05, 2017, from [https://www.health.harvard.edu/newsletter\\_article/what-are-the-real-risks\\_of-antidepressants](https://www.health.harvard.edu/newsletter_article/what-are-the-real-risks_of-antidepressants)
- Hendrie, G., Baird, D., Golley, R., & Noakes, M. (2017). The CSIRO Healthy Diet Score: An Online Survey to Estimate Compliance with the Australian Dietary Guidelines. *Nutrients*, 9(1), 47. doi:10.3390/nu9010047

- Hodge, A., Almeida, O. P., English, D. R., Giles, G. G., & Flicker, L. (2012). Patterns of dietary intake and psychological distress in older Australians: benefits not just from a Mediterranean diet. *International Psychogeriatrics*, 25(03), 456-466. doi:10.1017/s1041610212001986
- Johnson, D. P., & Whisman, M. A. (2013). Gender differences in rumination: A meta-analysis. *Personality and Individual Differences*, 55(4), 367-374. doi:10.1016/j.paid.2013.03.019
- Karvetti, R., & Knuts, L. (1992). Validity of the estimated food diary: comparison of 2-day recorded and observed food and nutrient intakes. *Journal of the American Dietetic Association*, 92(5), 580-584.
- Kelly, John R., et al. "Transferring the blues: Depression-Associated gut microbiota induces neurobehavioural changes in the rat." *Journal of Psychiatric Research*, vol. 82, Nov. 2016, pp. 109-118., doi:10.1016/j.jpsychires.2016.07.019.
- Kim, D., & Camilleri, M. (2000). Serotonin: a mediator of the brain-gut connection. *The American Journal of Gastroenterology*, 95(10), 2698-2709. doi:10.1016/s0002-9270(00)01970-5
- Kim, W. K., Shin, D., & Song, W. O. (2016). Are Dietary Patterns Associated with Depression in U.S. Adults? *Journal of Medicinal Food*, 19(11), 1074-1084. doi:10.1089/jmf.2016.0043
- Knight, R. (2014). The Gut-Brain Axis. Retrieved May 23, 2017, from <https://www.coursera.org/learn/microbiome/lecture/gkEVT/the-gut-brain-axis>
- Knüppel, A., Shipley, M. J., Llewellyn, C. H., & Brunner, E. J. (2017). Sugar intake from sweet food and beverages, common mental disorder and depression: prospective findings from the Whitehall II study. *Scientific Reports*, 7(1). doi:10.1038/s41598-017-05649-7
- Lai, J. S., Hiles, S., Bisquera, A., Hure, A. J., Mcevoy, M., & Attia, J. (2013). A systematic review and meta-analysis of dietary patterns and depression in community dwelling adults. *American Journal of Clinical Nutrition*, 99(1), 181-197. doi:10.3945/ajcn.113.069880
- Landau, C. (n.d.). Depression. Retrieved April 04, 2017, from <http://www.healthwomen.org/condition/depression>

- Legrand, F. D., & Neff, E. M. (2016). Efficacy of exercise as an adjunct treatment for clinically depressed inpatients during the initial stages of antidepressant pharmacotherapy: An open randomized controlled trial. *Journal of Affective Disorders, 191*, 139-144. doi:10.1016/j.jad.2015.11.047
- Lenoir, M., Serre, F., Cantin, L., & Ahmed, S. H. (2007). Intense Sweetness Surpasses Cocaine Reward. *PLoS ONE, 2*(8). doi:10.1371/journal.pone.0000698
- Levinson, D. F., M.D., & Nichols, W. E., M.D. (2017). Major Depression and Genetics. Retrieved from <http://depressiongenetics.stanford.edu/mddandgenes.html>
- Look AHEAD: Action for Health in Diabetes. (n.d.). Retrieved October 10, 2017, from <https://www.niddk.nih.gov/news/for-reporters/look-ahead-action-health-diabetes/Pages/default.aspx>
- Ludwig, D. S., Peterson, K. E., & Gortmaker, S. L. (2001). Relation between consumption of sugar-sweetened drinks and childhood obesity: a prospective, observational analysis. *The Lancet, 357*(9255), 505-508. doi:10.1016/s0140 6736(00)04041-1
- Luna, R. A., & Foster, J. A. (2015). Gut brain axis: diet microbiota interactions and implications for modulation of anxiety and depression. *Current Opinion in Biotechnology, 32*, 35-41. doi:10.1016/j.copbio.2014.10.007
- Lustig, R. H. (2016, October 27). *Fat Chance: The Bitter Truth about Sugar*. Lecture presented at Food and Addiction: Sugar, Stress, Environment, and Weight in UCSF, San Francisco . Retrieved from <http://www.ucsfcmecme.com.whsites.net/minimedicalschool/syllabus/spring2013/nutrition/6-19%20-%20Fat%20Chance%20-%20Lustig%20%20BW.pdf>
- Marmot, M., Stansfeld, S., Patel, C., North, F., Head, J., White, I., . . . Smith, G. (1991). Health inequalities among British civil servants: the Whitehall II study. *The Lancet, 337*(8754), 1387-1393. doi:10.1016/0140-6736(91)93068-k
- McGrath, E., Keita, G. P., Strickland, B. R., & Russo, N. F. (1990). *Women and depression: Risk factors and treatment issues*. Washington, DC: American Psychological Association.
- Mitchell, N., Catenacci, V., Wyatt, H. R., & Hill, J. O. (2011). Obesity: Overview of an Epidemic. *Psychiatric Clinical North America, 34*(4), 717-732. ] doi:10.1016/j.psc.2011.08.005

- Moschen, A. R., Wieser, V., & Tilg, H. (2012). Dietary Factors: Major Regulators of the Guts Microbiota. *Gut and Liver*, 6(4), 411-416.  
doi:10.5009/gnl.2012.6.4.411
- National Alliance on Mental Illness. (2017, August). Depression. Retrieved November 11, 2017, from <https://www.nami.org/Learn-More/Mental-Health-Conditions/Depression>
- NIH. (n.d.). Key Recommendations. Retrieved August 15, 2017, from [https://www.nhlbi.nih.gov/health/educational/lose\\_wt/recommen.htm](https://www.nhlbi.nih.gov/health/educational/lose_wt/recommen.htm)
- Ogden, C. L., Ph.D., Lamb, M. M., Ph.D., Carroll, M. D., M.S.P.H., & Flegal, K. M., Ph.D. (2010, December). *Obesity and Socioeconomic Status in Adults: United States, 2005–2008* (Issue brief No. 50). Retrieved <https://www.cdc.gov/nchs/data/databriefs/db50.pdf>
- Olson, K., MA, Bond, D., PhD, & Wing, R. R., PhD. (2017). Behavioral Approaches to the Treatment of Obesity. *Rhode Island Medical Journal*, 21-24. Retrieved from <http://www.rimed.org/rimedicaljournal/2017/03/2017-03-21-obesityolson.pdf>
- Onyike, C. U., Crum, R. M., Lee, H. B., Lyketsos, C. G., & Eaton, W. W. (2003). Is Obesity Associated with Major Depression? Results from the Third National Health and Nutrition Examination Survey. *American Journal of Epidemiology*, 158(12), 1139-1147. doi:10.1093/aje/kwg275
- Overweight and Obesity Statistics. (2012, October). Retrieved from <https://www.niddk.nih.gov>
- Popa, T., & Ladea, M. (2012). Nutrition and Depression at the Forefront of Progress. *Journal of Medicine and Life*, 5(4), 414-419.
- Powell, E. S., Smith-Taillie, L. P., & Popkin, B. M. (2016). Added Sugars Intake Across the Distribution of US Children and Adult Consumers: 1977–2012. *Journal of the Academy of Nutrition and Dietetics*, 116(10). doi:10.1016/j.jand.2016.06.003
- Radloff, L. S. (1977). The CES-D scale: A self report depression scale for research in the general population. *Applied Psychological Measurements*, 1, 385-401.
- Rahe, C., Unrath, M., & Berger, K. (2014). Dietary patterns and the risk of depression in adults: a systematic review of observational studies. *European Journal of Nutrition*, 53(4), 997-1013. doi:10.1007/s00394-014-0652-9

- Renzulli, K. A. (2016, April 8). 10 Most Expensive Cities to Be a Renter | Money. Retrieved November 02, 2017, from [http://time.com/money/4287132/most\\_expensive-cities-to-rent/](http://time.com/money/4287132/most_expensive-cities-to-rent/)
- Richard, A., Rohrmann, S., Vandeleur, C. L., Mohler-Kuo, M., & Eichholzer, M. (2015). Associations between fruit and vegetable consumption and psychological distress: results from a population-based study. *BMC Psychiatry, 15*(1). doi:10.1186/s12888-015-0597-4
- Sarris, J., Kavanagh, D. J., & Newton, R. (2008). Depression and Exercise. *Journal of Complementary Medicine, 7*(3), 48-50.
- Scale. *PsycTESTS Dataset*. doi:10.1037/t43282-000
- Speake, J., & Simpson, J. (2015). *The Oxford dictionary of proverbs* (6th ed.). Oxford: Oxford University Press.
- Stangor, C. (2011). Chapter 3 Brain and Behavior. *In Introduction to Psychology* (pp. 61-68). San Francisco, CA: Creative Commons Attribution-Noncommercial Share Alike 3.0.
- Subar, A. F., Thompson, F. E., Kipnis, V., Midthune, D., Hurwitz, P., McNutt, S., . . . Rosenfeld, S. (2001). Comparative Validation of the Block, Willett, and National Cancer Institute Food Frequency Questionnaires. *American Journal of Epidemiology, 154*(12), 1089-1099. doi:10.1093/aje/154.12.1089
- Sugar: The Bitter Truth [Television series episode]. (2009, July 30). In *The Skinny on Obesity*. San Francisco, California: University of California Television. Retrieved from <https://www.uctv.tv/skinny-on-obesity/>
- Tamers, S. L., Agurs-Collins, T., Dodd, K. W., & Nebeling, L. (2008). US and France adult fruit and vegetable consumption patterns: an international comparison. *European Journal of Clinical Nutrition, 63*(1), 11-17. doi:10.1038/ejcn.2008.2
- The Human Microbiome Project Consortium (2012). Structure, Function and Diversity of the Healthy Human Microbiome. *Nature, 486*(7402), 207-214. doi:10.1038/nature11234
- Thomas, J. G., & Bond, D. S. (2014). Review of innovations in digital health technology to promote weight control. *Current diabetes reports, 14*(5), 1-10.
- Thompson, F. E., Mcneel, T. S., Dowling, E. C., Midthune, D., Morrissette, M., & Zeruto, C. A. (2009). Interrelationships of Added Sugars Intake

- Socioeconomic Status, and Race/Ethnicity in Adults in the United States: National Health Interview Survey, 2005. *Journal of the American Dietetic Association*, 109(8), 1376-1383. doi:10.1016/j.jada.2009.05.002
- Tillisch, K., Mayer, E., Gupta, A., Gill, Z., Brazeilles, R., Nevé, B. L., . . . Labus, J. S. (2017). Brain structure and response to emotional stimuli as related to gut microbial profiles in healthy women. *Psychosomatic Medicine*, 1. doi:10.1097/psy.0000000000000493
- U.S. Department of Agriculture and U.S. Department of Health and Human Services. *Dietary Guidelines for Americans, 2010*. 7th Edition, Washington, DC: U.S. Government Printing Office, December 2010.
- U.S. Food and Drug Administration. (2017, October 10). Labeling & Nutrition Changes to the Nutrition Facts Label. Retrieved November 05, 2017, from <https://www.fda.gov/Food/GuidanceRegulation/GuidanceDocumentsRegulatoryInformation/LabelingNutrition/ucm385663.htm>
- United States Department of Agriculture, Economic Research Service. (2012). USDA Sugar Supply: Tables 51-53: US Consumption of Caloric Sweeteners. Retrieved from <http://www.ers.usda.gov/data-products/sugar-and-sweeteners-yearbook-tables.aspx>
- United States Department of Agriculture. (2016, November 09). What are added sugars? Retrieved August 28, 2017, from <https://www.choosemyplate.gov/what-are-added-sugars>
- Weaver, D., & Finke, M. (2003). The relationship between the use of sugar content information on nutrition labels and the consumption of added sugars. *Food Policy*, 28(3), 213-219. doi:10.1016/s0306-9192(03)00028-9
- Weissman MM, Bland RC, Canino GJ, Faravelli C, Greenwald S, Hwu HG, Joyce PR, Karam EG, Lee CK, Lellouch J, Lepine JP, Newman SC, Rubio-Stipec M, Wells JE, Wickramaratne PJ, Wittchen H, Yeh EK. 1996. Cross-national epidemiology of major depression and bipolar disorder. *JAMA* 276:293-239.
- Whitaker, K. M., Sharpe, P. A., Wilcox, S., & Hutto, B. E. (2014). Depressive symptoms are associated with dietary intake but not physical activity among overweight and obese women from disadvantaged neighborhoods. *Nutrition Research*, 34(4), 294-301. doi:10.1016/j.nutres.2014.01.007

- Willett, W. C., Sacks, F., Trichopoulou, A., Drescher, G., Ferro-Luzzi, A., Helsing, E., & Trichopoulos, D. (1995). Mediterranean diet pyramid: a cultural model for healthy eating. *The American Journal of Clinical Nutrition*, 61(6), 1402S-1406S. Retrieved from <http://ajcn.nutrition.org.jpplnet.sfsu.edu/content/61/6/1402S.short>
- Women and Depression. (2011). *Harvard Mental Health Letter*, 27(11). Retrieved from <http://www.health.harvard.edu/womens-health/women-and-depression>
- Women and Depression. (n.d.). Retrieved April 03, 2017, from <http://www.apa.org/about/gr/issues/women/depression.aspx>
- Wu, G. D., Chen, J., Hoffmann, C., Bittinger, K., Chen, Y., Keilbaugh, S. A., . . . Lewis, J. D. (2011). Linking Long-Term Dietary Patterns with Gut Microbial Enterotypes. *Science*, 334(6052), 105-108. doi:10.1126/science.1208344
- Yeoh, M. (2016). Lifestyle-Based Treatment OF ANXIETY AND DEPRESSION. *College of Nutritional & Environmental Medicine Journal*, 35(2), 11-13. Retrieved from <http://web.a.ebscohost.com>.
- Zhang, Q., & Wang, Y. (2004). Socioeconomic inequality of obesity in the United States: do gender, age, and ethnicity matter? *Social Science & Medicine*, 58(6), 1171-1180. doi:[https://doi.org/10.1016/S0277-9536\(03\)00288-0](https://doi.org/10.1016/S0277-9536(03)00288-0)
- Zhao, G., Ford, E. S., Dhingra, S., Li, C., Strine, T. W., & Mokdad, A. H. (2009). Depression and anxiety among US adults: associations with body mass index. *International Journal of Obesity*, 33(2), 257-266. doi:10.1038/ijo.2008.268

**Appendix 1: Recruitment script for Facebook support group pages**

Hi everyone,

My name is Adi and I'm currently conducting a study on the association of diet and depression at San Francisco State University. Depression is all too common in our society, and most of us have or know someone who has experienced it. Women are twice as likely as men to experience major depression, and while a lot of likely factors contribute to this, I have decided to examine diet.

If you are a woman between the ages of 18-55, please click the link below to the study survey. It will take about 10-20 minutes, and is completely anonymous.

If you are a man, out of the age range, or have already taken the survey- PLEASE SHARE IT! The more people take it, the deeper understanding we will have on our findings, and the more attention the results will get from people who can make a difference.

I know we are all busy and work, studies, family, and life get in the way of completing or sharing an online survey. I assure you, your response will make a difference. I really appreciate your time, and will happily share the results with anyone who is interested.

If you have any questions I can be reached at [afish@mail.sfsu.edu](mailto:afish@mail.sfsu.edu)

[https://sfsu.co1.qualtrics.com/SE/?SID=SV\\_0CYZERIRLPKvhLn](https://sfsu.co1.qualtrics.com/SE/?SID=SV_0CYZERIRLPKvhLn)

**Appendix 2: Recruitment script for Facebook personal page and congregation**

Hi everyone,

As some of you may know, I'm currently conducting a study on the association of diet and depression. Depression is all too common in our society, and most of us have or know someone who has experienced it. Women are twice as likely as men to experience major depression, and while a lot of likely factors contribute to this, I have decided to examine diet.

If you are a woman between the ages of 18-55, please click the link below to the study survey. It will take about 10-20 minutes, and is completely anonymous.

If you are a man, out of the age range, or have already taken the survey- PLEASE SHARE IT! The more people take it, the deeper understanding we will have on our findings, and the more attention the results will get from people who can make a difference.

I know we are all busy and work, studies, family, and life get in the way of completing or sharing an online survey. I assure you, your response will make a difference. I really appreciate your time, and will happily share the results with anyone who is interested.

If you have any questions I can be reached at [afish@mail.sfsu.edu](mailto:afish@mail.sfsu.edu)

[https://sfsu.co1.qualtrics.com/SE/?SID=SV\\_0CY YERIRLPKvhLn](https://sfsu.co1.qualtrics.com/SE/?SID=SV_0CY YERIRLPKvhLn)

### Appendix 3: Implied Consent Form



**SAN FRANCISCO  
STATE UNIVERSITY**

#### **Implied Consent to Participate in Research**

Data collected from this confidential survey will be used for completion of a master's degree in Consumer and Family Studies/ Dietetics Department at San Francisco State University. The information gathered will be used for research on about the associations between sugar consumption and major depression in women

The survey questions will be about diet, mental health, perceptions and knowledge about nutrition. You have been invited to participate because you are a woman between the ages of 18-55. You must be 18 years of age or older to participate. There are no risks or benefits to you in participating in this survey. You may choose to participate or not. You may answer only the questions you feel comfortable answering, and you may stop at any time. If you do not wish to participate, you may simply return the blank survey, with no penalty to yourself. If you do participate, completion and return of the survey indicates your consent to the above conditions. Your decision whether or not to participate in this research will have no influence on your present or future status at San Francisco State University. Please do not put your name on this form. The survey should take approximately 20-30 minutes to complete.

Any questions or concerns should be directed to the principal investigator, Adi Fish, at [afish@mail.sfsu.edu](mailto:afish@mail.sfsu.edu) or the research advisor, Professor Gretchen George, at [glgeorge@sfsu.edu](mailto:glgeorge@sfsu.edu)

>>

**Appendix 4: Survey**

Q3 Are you over the age of 18?

- Yes (1)
- No (2)

Q9 Please enter the year you were born:

---

Q5 Please choose your gender:

- Man (1)
- Woman (2)

Q1 Over the past 2 weeks, how often have you been bothered by any of the following problems?

	Not At All (1)	Several Days (2)	More Than Half the Days (3)	Nearly Every Day (4)
Little interest or pleasure in doing things (1)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Feeling down, depressed or hopeless (2)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Trouble falling asleep, staying asleep, or sleeping too much (3)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Feeling tired or having little energy (4)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Poor appetite or overeating (5)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Feeling bad about yourself - or that you're a failure or have let yourself or your family down (6)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Trouble concentrating on things, such as reading the newspaper or watching television (7)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Moving or speaking so slowly that other people could have noticed. Or, the opposite - being so fidgety or restless that you have been moving around a lot more than usual (8)

Thoughts that you would be better off dead or of hurting yourself in some way (9)

Q8 Do you perceive your mood being better when your diet is healthier?

- Yes (1)
- No (2)

Q7 Do you perceive your mood being worse when your diet is less healthy?

- Yes (1)
- No (2)

Q10 Please guess and select how much added sugar is in each of the following:

	0 grams (1)	9 grams (2)	18 grams (3)	39 grams (4)	49 grams (5)
Apple (1)	<input type="radio"/>				
Carrot (2)	<input type="radio"/>				
Strawberry yogurt (3)	<input type="radio"/>				
12oz can of cola (4)	<input type="radio"/>				

Q11 If you have ever consulted a health professional regarding depression, were you given any specific nutritional tips or advice?

- Yes (1)
- No (2)
- Not Applicable (3)

Q15 Are you pregnant or breast-feeding?

- No (1)
- Yes (2)

Q17 How much do you weigh (in pounds)?

---

Q19 How tall are you? (In feet and inches)

Q21 Over the past month, how often did you drink the following beverages per week?

	None or less than 1 (1)	1 day (2)	2 days (3)	3-4 days (4)	5-6 days (5)	every day (6)
How many days per week do you drink milk? (not counting cereal or coffee) (1)						
real 100% fruit juice, not counting fruit flavored soft drinks, or drinks like Sunny Delight (2)						
Vegetable juice, like tomato juice, V8, carrot (3)						

Q23 If you drink vegetable juice, how much do you drink each time have it?

- N/A (1)
- small 6 oz. glass (2)
- 1 cup (3)
- 2+ cups (4)

Q25 Over the past month, how often did you drink the following beverages?

	None or less than 1 (1)	1 day (2)	2 days (3)	3-4 days (4)	5-6 days (5)	every day (6)
How many days per week do you drink Snapple, Koolaid, instant lemonade, instant iced tea, cordian-regular or sugar free (1)						





Q41 How much real sugar or honey do you have when you add it to coffee or tea or on cereal?

- N/A (1)
- 1 teaspoon (2)
- 2 teaspoons (3)
- 3+ teaspoons (4)

Q43 How much cheese do you have when you eat it?

- N/A (1)
- 1 slice (2)
- 2 slices (3)
- 3+ slices (4)

Q45 How much lunch meat do you eat on the days you eat it?

- N/A (1)
- 1 slice (2)
- 2 slices (3)
- 3+ slices (4)

Q47 If you eat lunch meats are they usually

- N/A (1)
- Low fat or turkey (2)
- Regular (3)

Q49 Over the past month, how often did you eat the following foods?

	None or less than 1 (1)	1 day (2)	2 days (3)	3-4 days (4)	5-6 days (5)	every day (6)
Hamburgers, cheeseburgers, meat balls or meat loaf (1)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Hot dogs, or sausage like Polish, Italian, or chorizo (2)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Other beef or pork, such as steak, roast beef, ribs, or in sandwiches tacos, or burritos (3)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Q51 How much hamburger do you have on the days you have it?

- N/A (1)
- 3 oz. or 1 small (2)
- 1 large (3)
- 2 large (4)

Q53 How much hot dog or sausage of you have on the days you have it?

- N/A (1)
- 1 hotdog (2)
- 2 hotdogs (3)
- 3+ hotdogs (4)

Q55 If you eat hot dogs, are they usually:

- N/A (1)
- Low fat or turkey dogs (2)
- Regular hotdogs (3)

Q57 How much beef or pork do you have on the days you have it?

- N/A (1)
- 3 oz. small (2)
- 4-6 oz medium (3)
- 7+ oz large (4)

Q59 Over the past month, how often did you eat the following foods?

	None or less than 1 (1)	1 day (2)	2 days (3)	3-4 days (4)	5-6 days (5)	every day (6)
Fried chicken, including chicken nuggets, wings, chicken patty (1)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Fish of any kind (2)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Pizza (3)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Spaghetti, lasagna, or other pasta or noodles (4)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Q61 How much fish do you eat on the days you eat it?

- N/A (1)
- 2 oz. (2)
- 4 oz. (3)
- 6 oz. (4)

Q63 How much pizza do you have on the days you have it?

- N/A (1)
- 1 slice (2)
- 2 slices (3)
- 3+ slices (4)

Q65 How much spaghetti, lasagna, or other pasta or noodles do you have when you have it?

- N/A (1)
- 1 cup (2)
- 2 cups (3)
- 3+ cups (4)





any other  
kind of  
cracker (4)

Ice cream,  
ice cream  
bars (5)

Doughnuts  
(6)

Q83 How much bread do you have when you have it?

- N/A (1)
- 1 slice (2)
- 2 slices (3)
- 3+ slices (4)

Q85 What kind of bread do you usually eat?

- N/A (1)
- Regular sliced white bread (2)
- Dark bread like rye, cracked wheat (3)
- 100% whole wheat (4)

Q87 On the days you eat snack chips, how much do you usually eat?

- N/A (1)
- 1 small handful (2)
- 1 oz. bag (1 cup) (3)
- big bag (2+ cups) (4)

Q89 If you eat snacks like chips, are they usually:

- N/A (1)
- Trans-fat free (2)
- regular (3)

Q91 On the days you eat ice cream, how much do you usually eat?

- N/A (1)
- 1/2 cup (2)
- 1 cup (3)
- 2 cups (4)
- 3+ cups (5)

Q93 On the days you eat doughnuts, how many do you usually eat?

- N/A (1)
- 1 doughnut (2)
- 2+ doughnuts (3)

Q95 Over the past month, how often did you eat the following foods?

	None or less than 1 (1)	1 day (2)	2 days (3)	3-4 days (4)	5-6 days (5)	every day (6)
Cake, cookies, or snack cakes like cupcakes, Twinkies, or any kind of pastry (1)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Pie including fast food pies or snack pies (2)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Chocolate candy like chocolate bars, M&M's, Reese's (3)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Any other candy, not chocolate, like hard candy, Lifesavers, Skittles, Starburst (4)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Q97 On the days you eat cakes, cookies, or cupcakes, how much do you usually eat?

- N/A (1)
- 1 small slice (2)
- 1 medium slice (3)
- 1 large slice (4)
- 2 or more slices (5)

Q99 On the days you eat pies, how much do you usually eat?

- N/A (1)
- 1 slice (2)
- 2 slices (3)
- 3+ slices (4)

Q101 On the days you eat chocolate candy, how much do you usually eat?

- N/A (1)
- 1 mini (2)
- 1 medium (3)
- 1 large (4)

Q103 If you eat chocolate candy, is it usually

- N/A (1)
- low carb, low sugar (2)
- low fat (3)
- regular (4)

Q105 When you eat candy that is not chocolate, how much do you usually eat?

- N/A (1)
- 1-2 pieces (2)
- Handful (3)
- 2 handfuls (4)
- 3 handfuls (5)

Q107 In the past month, how many times per week have you consumed the following:

	None or less than 1 (1)	1 day (2)	2 days (3)	3-4 days (4)	every day (5)
Margarine (not butter) on bread or on vegetables (1)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Butter (not margarine) on bread or on vegetables (2)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Fat or oil in cooking (3)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Q109 How much margarine do you eat on days you eat it?

- N/A (1)
- 1 teaspoon (2)
- 2 teaspoons (3)
- 3+ teaspoons (4)

Q111 How much butter do you eat on days you eat it?

- N/A (1)
- 1 teaspoon (2)
- 2 teaspoons (3)
- 3+ teaspoons (4)

Q113 How much fat or oil do you use on days you use it for cooking?

- N/A (1)
- 1 teaspoon (2)
- 2 teaspoons (3)
- 3+ teaspoons (4)

Q115 What kind of fat or oil do you usually use in cooking?

Choose 1 or 2

- N/A (1)
- Spray oil (like Pam) (2)
- Butter (3)
- Butter/ margarine blend (4)
- Stick margarine (5)
- Soft tub margarine (6)
- Low-fat margarine (7)
- Corn oil, vegetable oil (8)
- Olive oil, canola oil (9)
- Lard, fatback, bacon fat (10)
- Crisco (11)
- Trans-fat free brand (12)

Q117 What race do you consider yourself to be?

- White (1)
- Black or African American (2)
- American Indian or Alaska Native (3)
- Asian (4)
- Native Hawaiian or Pacific Islander (5)
- Hispanic or Latino (6)
- Other (7)
- Do not wish to provide this information (8)

End of Block: block