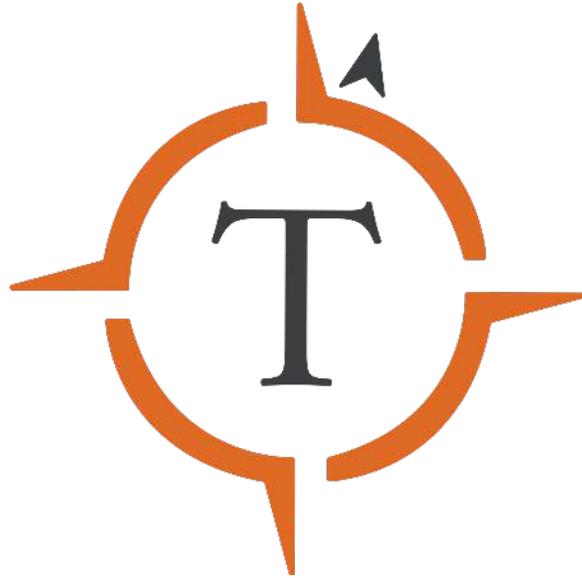


Tahoe Expedition Academy



The Mental Impacts of Nutrition

Food is Medicine

By, Gianna Putnam

Individual Senior Intensive

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Introduction: Fast Food vs. Vegetables

When I was a freshman in high school, my lunches included bagels with cream cheese and sugar-filled smoothies. Sometimes it included a trip across the street to 7-11 to get Hello Panda cookies and spicy Cheeto puffs for my nutritious lunch. I was young and ate whatever I wanted, ignoring any consequences that could arise to my mental and physical health. Adults tell young kids to "eat whatever you want while you're young." I believe that should never be followed due to the high amount of young teenagers having mental disorders. I began to deal with terrible gut health, which caused me to be bloated even when no food had been eaten. It took a lot of time and cutting out a variety of foods to discover that gluten was the culprit in my body. Entering the sophomore year, I began my love for nutrition but always had a curiosity about how food can cause our mental cognitive behavior to change or become aggressive. Then, once in that state, how it could return to being healthy.

According to a study done by the National Institute of Mental Health, 1 in 5 teens have a mental illness, and more than 80% of U.S teens have unhealthy eating habits. Along with the study, it was found that anxiety disorders, such as panic disorders and social phobia, were the most common conditions (31.9% with the disorder), followed by behavior disorders, including ADHD (19.1%), mood disorders, such as major depressive disorder (14.3%), and substance use disorders (11.4 %). This data shows that when exposed to different nutrients or amounts of food, young adults tend to develop mental health challenges.

There have been many books, experiments, and research papers created over the vast ideas of the correlation between food and the human brain and body. Scientists and doctors have been looking for the answers longer than many would imagine. Throughout this research paper, different experiments and research are provided related to the impact the mind and body have when deprived of specific foods and their implications towards inflammatory foods.

The Minnesota Starvation Experiment

The Great Starvation Experiment began in 1944 and ended in 1945. According to Phil Anderson in his writing on MNopedia.org, the experiment took place in Minneapolis, Minnesota, with 36 men run by Ancel Keys. The men came from World War II, where the greatest killer was starvation rather than bullets. Keys was born in 1904 and died in 2004. He was an American psychologist who studied the influence of diet on health. Before working with people, he first began examining fish weight based on their length. One of his most significant discoveries was the founding of the problem of saturated fats, causing an increase in LDL cholesterol (low-density lipoprotein, or “bad” cholesterol) twice as much as polyunsaturated fats lowering cholesterol.

In wars, the American troops would use K-rations, which are portable combat food rations that they would carry. Keys decided to dive into an experiment around starvation because he had an interest in nutrition. Not only that, but there was a loss of connection from doctors on the psychological and physiological effects of deprivation, especially on troops after the war had ended. He hoped his findings would bring an answer and understanding of those physiological effects as well as help Europe's population not decrease any more after wars. He created a design for this one year experiment. He began by dividing the study into three parts. The first part would last three months and be the control period with standard levels of food intake. The second part would last six months, where the starvation phase would begin. Then, the final part would be the reintroduction of food. His goal was to see the impacts of these men when he

starved them then refed them quickly. Keys was able to advertise his experiment well enough to get 36 volunteers.

The first stage of the Starvation Experiment took off in November of 1944. Keys had each man start at 3,200 calories a day. He also put them through daily tests, checking their heart size, blood volume, hearing, vision, body fat, and sperm count. Keys had the men remaining active, keeping jobs, and walking at least 22 miles a week. There were no issues in this first stage because the 32 men were keeping healthy and active lifestyles.

On February 12, 1945, Keys began the second stage of the Starvation Experiment. He started the starvation phase by cutting the calories count for the men from 3,200 calories to 1,570. The meals that the men ate were cooked and prepared by the people Keys had on hand. He purposely controlled their meals and made them high in carbohydrates and low in protein. Keys did this because people in Europe tend to eat high carb low protein diets, so he wanted to make it as similar as possible. During the caloric deficit, the men were to keep up with their active lifestyles and a minimum of 22 mile walks weekly. Right away, Keys noticed a 21% decrease in energy and strength. Not only were there drastic physical changes but data for the mental changes as well. Before the experiment, the men had strong political views, but with their minds occupied with food, those views disintegrated. The men as well had no sex drive, and food became their drive every day. They would look at cookbooks and admire the images of food. Many of the men were angered towards foods, especially if they were not fed at the exact times meals were at, or if the line for their meals were too long. Keys had the cooks making bland food, but the men

thought it was delicious and savored every bite of each meal. The men were allowed to have gum and coffee whenever they wanted. Which, according to Wikipedia, led to 40 packs of gum being chewed and 15 cups of coffee being drunk between each meal. The men began to become tremendously mental to the point that they would try to sneak in food but were instantly caught. Keys had to implement a buddy system to prevent any food from being snuck into the experiment. One man who cheated drastically with food was Franklin Watkins. As reported by Wikipedia, Watkins was 24 years old and spent his days in the starvation period dreaming about cannibalism and eating the fellow men in the experiment. Watkins was filled with so much anger he threatened to kill Keys and take his own life. Keys sent him away once the threat was made and put him in a psychiatric ward. Watkins recovered after having a balanced diet of food. Towards the end of the second stage, Keys was able to identify some of the main physiological changes. The men's heart rates slowed down due to their metabolism working slowly to conserve the minimal calories they got. Their skin became rough and course due to the hardening of hair follicles, and they all experienced their eyeballs whitening as their blood vessels shrank. The men struggled to sleep and sit due to the uncomfortableness of their bones sticking out on hard surfaces. Keys also noticed that their hearing improved when they continued to lose weight. Instead of viewing themselves as very underweight, the men believed everyone else was just overweight.

In August, the second phase of the experiment ended, and the third stage of rehabilitation began. After six months in the starvation phase, the men lost a quarter of their weight. Keys decided to group the men into four groups and gave them 400, 800, 1200, or 1600 more calories rather than

bringing back the 3,200 right away. He was interested in seeing the change when increased by a vast difference in calories. The men who received the lowest amount of increase in calories didn't notice anything. They felt as if the 400 calorie increase was nothing, and they were still eating the same amount. Keys tested out using supplements for vitamins and proteins to replace calories, but they did nothing. He was quickly able to see the only way the men could recover was with a mass surplus of calories, around 4,000.

After the year-long Starvation Experiment ended, Keys was able to see that his data showed that the starvation didn't appear to have any long-term negative impacts on health. He was able to see and have proof that the human body was designed to abstain long periods without food or minimal food. Despite these positive findings, the men had a few challenges after. They had a sensation of hunger they couldn't reach, and many were haunted by the fact that food may be taken away from them again. The experiment gave evidence towards those who starve themselves and deprive themselves of certain foods and the impacts. When one goes through the psychological effects of an eating disorder they feel the same way the men did, perfect size, and everyone else was overweight. When people deprive themselves they dream of the food, fond over the thoughts and smell, and dream of the consumption. Those who have eating disorders can overcome them and avoid the physiological risks if treated quickly. The men in the experiment recovered with no physiological changes and no long-lasting issues inside of their bodies when given a mass amount of food in recovery. The issues occur inside the body and not only mentally when one deprives themselves for too long.

Food is Mood

What we eat is how we feel; Food is our mood. Some agree, and some do not. Those who experience food guilt tend to see food in terms of good and evil, calories in and calories out. According to Lindsey Smith, author of *No More Food Guilt*, 99% of people attempt a diet, and only 2% succeed in weight loss and diet goals. In America, there are high standards that many people feel they need to meet. We like to think that if we do X, we will get Y as a result. In America, many people define people by their size, appearance, and financial status. Even if this is not on purpose, it is a norm for many. Weight is just another measurement in American culture. Many people start new diets in hopes that it will compensate for the cookies and cake that was eaten the previous day. Poor relationships with food are caused by fear of not having enough, stress eating, feeling alone, a coping mechanism, and eating to feel an emotion that humans lack. Food is a social and emotional component in life.

Hormones are a huge part of our body's digestive system, emotions, everything. Smith states that 95% of our body's stress hormones are located in the gut, which makes the stomach the first responder to stress. Any type of stress, whether it is good or bad, causes bodies to move into a fight or flight response. The fight or flight response is the physiological response that the body goes into when faced with fear or harmful events. During this state, the body focuses on fighting off the attacker, running to get away, or strategizing the next move. When in this mode, the last thing the body is focusing on is the digestion of the food eaten prior. When the stress arises from the unhealthy brownie eaten before the flight-or-fight response is triggered it leads to the body

being unable to digest. If the body can not absorb the essential nutrients that it needs, acid refluxes occur, and an upset stomach can arise. Other kinds of hormones, like menstruation cycles, can cause cravings of iron-enriched foods a week before it begins. When a woman enters their menstruation cycle, magnesium levels are lowered, causing cravings of chocolate. There are as well self-sabotaging hormones that occur when we freak out. For example, when one deprives themselves of specific foods, it leads to a freakout and a possible act of binging on unhealthy foods.

Many foods are shown to cause specific changes in the body, physically and mentally. Sugar is a huge one that everyone eats every day. Foods that contain high sugar offer a temporary satisfaction or a high that allows people to escape from pain or a sad feeling they have. This sugar high is only brief and not long term leading people to consume it in high quantities daily. Eating sugar brings issues of weight, diabetes, anxiety, depression, and possible cancer. In the brain, the consumption of sugar causes a negative mind-set, foggy thinking, fatigue, anxiety, or depression. Another food that is consumed daily in life is white flour. Foods containing white flour are considered empty because they are stripped of all the nutritious value they once had before becoming processed. When this process occurs in white flour, flour loses its vitamins, minerals, and fiber. This once unprocessed food is now processed, so when it leaves our body we are still unsatisfied and craving the nutrients that only whole foods can provide.

Many people have cravings; maybe it's a burger from the commercial one had just watched or a sweet smell from outside. When one dismisses those cravings, that cookie or burger, they are

robbing themselves of the opportunity to grow. When ignoring the cravings, the feelings that are mainly felt are guilt, sadness, and dissatisfaction. Each year there are usually four different seasons. Within those seasons, different kinds of meals and drinks are typically eaten. For example, in the summer, cold foods are craved, and in the fall and winter warm, comforting foods are craved. Not only does our body randomly have that craving for chocolate, but when the warmer weather comes around, it is easier to say, "I am craving ice cream." For some, these cravings come from emotional memories, but not all. Longing that ice cream in the winter instead of summer could result from feeling sad about a memory that happened in the summer days. Also, craving junk food on a day that something tragic occurred could be a result of the correlation; junk food is bad for you, and that specific day was bad for you.

The brain has many neurotransmitters that bring out different mental changes and feelings. 80% of serotonin is made in the gut and controls mood, sleep patterns, and appetite. If you do not eat well, you won't be able to make serotonin. Epinephrine is where our adrenaline comes from bringing us alertness and mental focus, but too much can cause high levels of anxiety.

Norepinephrine causes the brain to function and works to improve memory, mental energy, and one's attention span. Another neurotransmitter is GABA, which helps calm the body and reduce anxiety. Many neurotransmitters in the body control thoughts, emotions, development, and more. All are needed to function at its best ability. When the body is lacking in those categories, it could be from a lack of a specific neurotransmitter. Keeping a balanced healthy diet keeps one's neurotransmitters in place leading to a clear cognitive-behavior and a reduction of negative mood swings.

Gluten and Dairy: Your Body's Favorite Sabotagers

Gluten is a composite of proteins that is found in wheat mixed with similar proteins that are found in grains such as rye, corn, and barley. Wheat is one of the most processed foods in our diet because of the high-glycemic flour, sugar, and the modified vegetable oils inside of it. According to Kelly Bogan, MD dairy is, “homogenized and pasteurized, creating a dead, high-sugar liquid with distorted fats, denatured proteins, and unabsorbable or thoroughly destroyed vitamins.” Gluten and dairy are known to be two foods that sabotage the brain tremendously. Lectin, carbohydrate-binding proteins, is in grains, nightshade plants, and proteins in dairy and gluten. Lectins can trigger intestinal changes and inflammation. Diet is a huge part of keeping our guts healthy. Casein is dairy's biggest protein that takes a long time to digest causing the body to go through a lot of work to process it, especially in the gut.

The human gut acts as a second brain and is the first responder to stress. Constant stress leads the response in the gut to eventually increase cortisol levels, weaken the immune system, and cause chronic inflammation. The bacteria that are inside our gut can determine the sensitivity to inflammatories and the effects of gluten. Gut bacteria sends messages to the body, but most importantly to the cognitive messenger: the brain. According to gluten-researcher, Dr. Hadjivassiliou, gluten sensitivity can be primarily, and at times, exclusively, a neurological disease. Everyone reacts to gluten in different ways, but some bodies take gluten as a toxin. If

one does not notice this reaction they begin to have side effects beginning from fatigue and bloating to severe reactions like malnutrition and intestinal damage.

Not only are there physiological effects of the consumption of gluten and dairy, but also psychological effects. A study was published in *Alimentary Pharmacology and Therapeutics* in May of 2014 that aimed to show the psychological effects of people who are not celiac but possibly have a gluten sensitivity. According to the study published on Pubmed, there were 22 participants who ate a gluten-free diet for three days, then at random received one of three dietary challenges for another three days. The three dietary challenges given at random was either a placebo, whey, or a supplement with gluten. The results of the experiment stated that those who consumed gluten had a higher STPI (psychological tool) depression score than those who had the placebo. In conclusion to the experiment, it was also shown that short-term exposure to gluten-induced feelings of depression.

Kelly Brogan MD discusses how dairy is one of the most commonly reported problematic foods. Brogan states the reasoning, “has to do with receptors in the gut and brain that react to the casein and create antibodies as a response. This creates symptoms that could even mimic bipolar disorder and create a havoc of stress in the body.” The main issue underlying dairy is its protein, casein. Casein has been linked to being addictive but also linked to depression and aggression. Casein takes a long time to digest which is one of the big reasons why many reach for a piece of cheese to hold them over for a long period of time.

Researchers have found a link between gluten and dairy in those who have Autism. ADHD.org states that Jaak Panskeep created the opioid excess theory in 1979. According to Wikipedia, the opioid excess theory, “postulates that autism is the result of a metabolic disorder in which opioid peptides produced through the metabolism of gluten and casein pass through an abnormally permeable intestinal membrane and then proceed to exert an effect on neurotransmission through binding with opioid receptors”. Researchers have found a connection with exorphin (derived from partially digested food proteins) opioids in dairy protein and gluten. The gluten and the dairy protein casein are shown to have crossed the blood-brain barrier which when crossed causes social indifference symptoms. Scientists have noticed improvements in children with Autism who have gluten and dairy-free diets.

Gut Bacteria: Ooey Gooey Insides

There is a movement in opposite directions that communicate between the gut and the brain. Scientists such as Dr. Michael Gershon, professor of Pathology and Cell Biology and father of neurogastroenterology, believe that we have a second brain in our gut. The human gut is lined with more than 100 million nerve cells, that's more than the nervous system has. All of these nerve cells in the stomach show us that when antibiotics disturb the ecosystem in our gut, mental disorders are correlated with diseases to the nervous system that may occur, influencing our mood. Irritable bowel syndrome (IBS) occurs when there is a large amount of abdominal pain and changes in bowel movements pattern with no evidence as to why. Due to the millions of nerve cells lining our gut, it is easy for scientists to see why mood disorders are so common in those with IBS.

Serotonin, which is a neurotransmitter in the body that correlates with the mood of being happy, also occurs in the gut. Marwa Azab Ph.D. states that "90 percent of serotonin is manufactured in the digestive tract and not the brain." When someone is depressed and takes antidepressants, the antidepressants work to increase the serotonin in the gut to improve one's mood. As talked about in the Food Mood section, the gut bacteria also produce the neurotransmitters dopamine, norephedrine, and GABA. Again, these neurotransmitters are critical for mood, anxiety, concentration, and motivation. Gut microbiome "is a community of microorganisms (such as bacteria, fungi, and viruses) that inhabit a particular environment and especially the collection of

microorganisms living in or on the human body." The gut microbiome can cause changes in how the brain reacts.

There are many kinds of functional and nonfunctional gut bacteria foods. For example, some inflammatory foods (nonfunctional) are fast food, gluten, dairy, sugar, and food dyes. A study done at UCLA worked to see the effects of good and bad gut bacteria foods. They began by taking a group of healthy women with no psychiatric symptoms and no gastrointestinal (organ in the system that carries food and digests it while extracting energy and nutrients) symptoms like constipation. The women were separated into three groups. The first group was given a fermented milk product with probiotics (i.e., yogurt). The second group was assigned a non-fermented milk product (i.e., cream) and the last group was to remain eating their typical everyday diets without yogurt. The experiment lasted four weeks, with each group eating their pro or non-probiotic two times daily. The researchers on the experiment took scans of each woman's brain before and after the four weeks to see if there were any brain changes in response to an emotional attention task. The results showed the women who consumed the fermented milk had calmer brains, and the no yogurt group showed the opposite trend with more brain activity. Stress can cause the gut to have more bacteria and cause the digestive system to not work properly. Many believe there is a linkage between depression being caused by dysfunctional gut-brain-immune system interactions.

Having mostly good gut bacteria decreases the chances of negative mood swings, uncontrolled blood sugar, diabetes risk, and risk of heart diseases. When we fill our bodies with inflammatory

foods, we are filling our gut with more bad bacteria than good. Dr. Emerman Mayer states, “There are studies showing that what we eat can alter the composition and products of the gut flora — in particular, that people with high-vegetable, fiber-based diets have a different composition of their microbiota or gut environment than people who eat the more typical Western diet that is high in fat and carbohydrates.”

Conclusion: You Are What You Eat - Inside and Out

The correlation between diet and cognitive behavior has been understudied and as a result, Americans lack an informative and complex understanding of the effect it has. The connection between mental health and food is shown when one deprives themselves of nutrients for long periods of time. The brain processes self-image and obsession with food in ways it does not when given the nutrients it is needed daily. Gluten, dairy, and sugar are huge culprits for the brain and gut, but sadly are American's favorites. The American people need to decrease their consumption in order to have better cognitive behavior, healthier microbiome, fewer health risks, and overall less negative moods. When meeting with experts, there is a difference in opinions towards whether what we eat can control how we feel. Bodies crave unhealthy foods during different seasons, when a rough period in one's life occurs, or for women during their menstruation cycle. The craving of sugar comes with the hope our sad mood will improve, but it is a high that goes away leading to constant consumption, unhappy moods, fatigue, and possibly depression. In general, neurotransmitters cannot work properly and give one's mind and body the necessities it needs to thrive when one eats an unhealthy diet. Eating a mostly healthy diet allows for serotonin to be able to control one's mood and allows norepinephrine to keep one's mental focus at its prime. Having a healthy microbiome, low risk to health diseases, positive attitudes and moods, clear cognitive behavior, and overall more energy does not come from just unprocessed healthy foods, it can come from one consuming unhealthy and processed foods in moderation.

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