

Lessons from History: The Minnesota Starvation Experiment Webinar Transcript

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la-shell_johnson@med.unc.edu: Good afternoon and welcome to today's webinar titled, "Lessons from History: The Minnesota Starvation Experiment."

la-shell_johnson@med.unc.edu: There are a few things to note regarding today's webinar. Participants will be muted upon entry and videos turned off. For technical assistance, we ask that you use the chat box. Number three, you will also receive an email in approximately three months requesting feedback and impact on this presentation. And lastly, we ask for you to visit us at www.nceedus.org/training to view other training opportunities that we may have.

la-shell_johnson@med.unc.edu: In addition, an evaluation form and slides from today's presentation will be sent out tomorrow morning.

la-shell_johnson@med.unc.edu: We will also have a 10 minute question and answer segment available at the end of this presentation. For any unanswered questions will be able to send you those responses from the presenter by email within one week from today's presentation. I will now introduce today's presenter.

la-shell_johnson@med.unc.edu: Today's presenter is Dr. Tonya Foreman, a Professor of Psychiatry at the University of North Carolina Chapel Hill. She graduated from the University of Kentucky College of Medicine.

la-shell_johnson@med.unc.edu: And she did an adult psychiatry residency at Vanderbilt University, a child and adolescent psychiatry fellowship at the University of Florida, and a forensic psychiatry fellowship at Yale University.

la-shell_johnson@med.unc.edu: Before coming to UNC in 2017, Dr. Foreman was on the medical school faculties of Tulane University, the University of Louisville, and Indiana University.

la-shell_johnson@med.unc.edu: She has won numerous awards, including that Ginsburg Fellowship from the Group for the Advancement of Psychiatry and the Rappaport Fellowship from the American Academy of Psychiatry and Law.

la-shell_johnson@med.unc.edu: Her clinical area focus is eating disorders. I will now turn things over to Dr. Tonya Foreman.

Tonya Foreman: Hey everyone, today's talk is called, "Lessons from History: The Minnesota Starvation Experiment."

Tonya Foreman: La-Shell, I seem to be locked up.

la-shell_johnson@med.unc.edu: You might need to go back into the presentation.

la-shell_johnson@med.unc.edu: Okay, probably go to presentation, yeah let's see if you can do that okay.

Tonya Foreman: Here we go.

Tonya Foreman: I do have a trigger warning, this presentation contains photographs of people who have undergone semi-starvation. The Minnesota Starvation study was conducted by Dr. Ancel Keys at the University of Minnesota in 1945.

Tonya Foreman: The participants were 36 men who were conscientious objectors during World War II. The goal of the experiment was to study the effects of starvation.

Tonya Foreman: This is Ancel Keys, the principal investigator of the study. He was an interesting character in his developmental years laid the groundwork for his later interest in starvation.

Tonya Foreman: He was born in 1904 in Colorado Springs to working class parents. After the great earthquake of 1906, his family moved to Los Angeles, where he spent time with his uncle.

Tonya Foreman: His uncle was Lon Chaney, a famous silent film actor, who was known as the man of 1000 faces. He was in the Hunchback of Notre Dame and the Phantom of the Opera.

Tonya Foreman: Lon's parents, the grandparents of Ancel Keys, were deaf and legend has it that Lon Chaney learned to communicate silently by pantomiming with his deaf parents.

Tonya Foreman: Ancel Keys spent much of his childhood in Berkeley California. His father worked in a print shop, his mother was a housewife, and neither parent had a college education.

Tonya Foreman: Young Ancel Keys was not particularly studious, in fact, he was sort of a rascal. When Keys was approximately 10 years old, he and 2 friends ran away to Grizzly Peak, and the pals survived for 3 days by eating only prunes, bacon, and Aunt Jemima pancakes cooked over a campfire.

Tonya Foreman: At the age of 15, Keys ran away from home again. He left a note for his mother and hitched a ride from California to Oatman, Arizona.

Tonya Foreman: He got a job in a cave shoveling bat guano into bags to be used by fertilizer manufacturers. He was by himself and had only cold sandwiches to eat.

Tonya Foreman: Each morning a truck brought him fresh food and water and took away his bags of guano. He had no wood to build a fire, no light, no books. Keys did this for three months. After his solitary experience in Arizona, he went back to Berkeley and became more interested in school. Three months of shoveling bat guano taught him the value of an education.

Tonya Foreman: Keys completed high school, then he went to college at UC Berkeley, and graduated in only three years with a degree in economics and political science.

Tonya Foreman: After college, he got married and became a management trainer at Woolworth but neither his job or his marriage was adequately exciting to him, and he left both within a few months.

Tonya Foreman: Even though he had never taken a single college biology class, Keys returned to college and studied day and night and received a Master's Degree in Zoology in six months.

Tonya Foreman: He was offered an internship at the Scripps Institution of Oceanography. At Scripps, he began studying fish survival in low oxygen water.

Tonya Foreman: The goal was to see how oxygen deprivation affected the vertebral development of fish. This research was likely the origin of his lifelong exploration of living in extreme conditions.

Tonya Foreman: Keys received his first PhD and moved to Copenhagen to study after that he moved to Cambridge for more education.

Tonya Foreman: At Cambridge, Keys studied with a scientist named Professor Joseph Barcroft. Barcroft became famous researching the effects of cold temperatures on the nervous system.

Tonya Foreman: As part of his experiments, Barcroft laid naked on a couch in sub-freezing temperatures for an hour at a time and recorded his impressions in a notebook.

Tonya Foreman: With Dr. Barcroft, Ancel Keys also studied the effects of high altitudes on human physiology. Keys received a second PhD from King's College in Cambridge. He went on to study altitude at Harvard and then at the Mayo Clinic.

Tonya Foreman: In 1938, Ancel Keys accepted a position at the University of Minnesota in Minneapolis. His task was to start a new institute.

Tonya Foreman: The Laboratory of Physiological Hygiene. It's vague charter was "to try to find out why people got sick before they got sick."

Tonya Foreman: His goal for his research was to study, "the exact measurement of human function and the factors affecting human performance and behavior."

Tonya Foreman: In a lack of self-confidence and he boldly wrote, “these are not questions of medicine or physiology or biochemistry or psychology or physical education, but invade and partake of all.”

Tonya Foreman: The University of Minnesota's athletic department funded some of Keys' research on the size of the hearts of athletes versus non-athletes.

Tonya Foreman: He disproves the prevailing idea that athlete's hearts were bigger than those of non-athletes, he also studied military rations.

Tonya Foreman: Let's switch gears for a couple minutes to take a deeper dive into the history of military rations.

Tonya Foreman: Napoleon Bonaparte is famously quoted as having said, “an army marches on its stomach.” For much of history, soldiers had to live off the land or pillage food from citizens or soldiers of the enemy. Malnutrition and disease were major causes of death for soldiers.

Tonya Foreman: In 1775 soldiers fighting in the US Revolution received packs, including one pound of beef, one quarter pound of pork, or one pound of salt fish, one pound of bread or flour, three pints of peas or beans, one pint of milk, one half pint, of rice or kind of corn meal, and one quart of spruce beer or cider.

Tonya Foreman: During the Civil War, some progress has been made in the preservation of food. Rum rations given during previous wars were eliminated, but Union soldiers' rations included coffee, tea, and seasonings. Soldiers also ate biscuits called hardtack.

Tonya Foreman: Hardtack is made of flour, water, and sometimes some salt or sugar. It has an extremely long shelf life if kept dry. In fact, there are some actual Civil War hardtack on display in museums.

Tonya Foreman: During World War I, the military started trying to customize rations depending on the tactical situation. They developed several types of rations. Garrison rations included perishable foods like bread and wheat.

Tonya Foreman: Sorry, like meat and bread. Trench or emergency rations included beef powder and wheat cakes and a few one-ounce chocolate bars.

Tonya Foreman: Trench rations were kept in large steel cans designed to withstand chemical attacks. Another category was the reserve ration.

Tonya Foreman: Which were non-perishable and were somewhere between the garrison rations and the trench rations. Reserve rations were meant to supply an entire day of food.

Tonya Foreman: And a reserve ration contained a one pound can of meat, two eight-ounce tins of hard bread 2.4 ounces of sugar, one ounce of ground coffee, and 0.16 ounces of salt, but these rations were bulky.

Tonya Foreman: As we moved into World War II, the goal became to provide the highest possible caloric value in the smallest possible package.

Tonya Foreman: By 1941, it was clear that the next war would require extensive use of airborne soldiers, tank troops, and other small highly mobile units.

Tonya Foreman: The army contacted Keys about designing a new paratrooper ration that would be highly portable.

Tonya Foreman: Rations evolved in the contents were refined until it became the K ration. The K ration might or might not have been named after Keys.

Tonya Foreman: The final version of the K ration contained 2,830 calories and was packaged by the Wrigley's chewing gum factory in Chicago.

Tonya Foreman: Breakfast was malted milk tablets and canned veal loaf and instant coffee. Lunch was dextrose tablets, canned ham spread, and bouillon.

Tonya Foreman: Dinner was chocolate, sausage, lemonade, and sugar. The soldiers also received 4 cigarettes. The rations contained approximately 33 grams of protein and were

slightly under the daily recommendations for vitamins, the only source of vitamin C was the lemonade powder.

Tonya Foreman: Here is a box for breakfast K ration.

Tonya Foreman: In 1944 the army use the K rations for personnel beyond the paratroopers and it produced more than 100 million K rations that year.

Tonya Foreman: Soldiers became fond of the K rations not only for their food, but also for the packaging.

Tonya Foreman: They use the packaging as a drinking cup, a boot insole, and as a way to start fire. The boxes, if they look familiar to you, you're above a certain age are actually Cracker Jack boxes.

Tonya Foreman: The K rations were important precursors to current day MREs used by the by the military.

Tonya Foreman: Keys was named Special Assistant to the Secretary of war. He became involved with more and more military research, including a study on heat stress and a new way to evaluate physical fitness. He also decided to pursue a study on the effects of starvation.

Tonya Foreman: When I talk to people about the Minnesota Starvation Experiment, one of their first responses is often,

Tonya Foreman: "They starved people in a research study? That would never be allowed to happen today." But I think it's important to consider the study in its historical context. World War II began in 1939 when Germany invaded Poland. The invasion of Dunkirk was in 1940.

Tonya Foreman: The attack on Pearl Harbor was on December 7, 1941.

Tonya Foreman: June 6, 1944 was the invasion of Normandy or D-Day.

Tonya Foreman: And just a few months later on November 19, 1944, Keys began his starvation experiment.

Tonya Foreman: But why? After Keys work on military nutrition, it became natural time to look at the larger issue of world hunger.

Tonya Foreman: Keys persuaded several sponsors that starvation had never been studied in a systematic scientific way. Keys observed the history of man is largely in history of the quest for food, but it didn't never been formally studied.

Tonya Foreman: The Minnesota Starvation Study was timely for several reasons.

Tonya Foreman: The war was taking a terrible toll on the world's food supplies and was devastating the world's infrastructure for food processing and distribution. Rationing the food was common.

Tonya Foreman: There were famines in Europe and Asia including the Dutch famine of 1944 and 1945. People were concerned that, after the war, hungry people could be difficult to manage and that could be a breeding ground for revolts and communism.

Tonya Foreman: And we knew we needed to understand the physical and mental states of concentration camp survivors, as we hope for their release.

Tonya Foreman: We also needed to know if there was an optimal way to re-nourish people. There was a desire to determine whether there was an ideal substance to use for feeding, i.e. a formula or supplement combination that can be delivered on a mass scale.

Tonya Foreman: In the end, Keys combination of national security, humanitarian and scientific arguments was effective, he persuaded people that his study was important and timely.

Tonya Foreman: The starvation project received funding from the Sugar Research Council, the National Dairy Council, the Office of the Surgeon General, the athletic department of the University of Minnesota, and some private industries. He was also given money by historic peace churches.

Tonya Foreman: When Ancel Keys set out to find volunteers for his studies, Americans and people around the world were already used to being asked to make personal sacrifices for the good of others. Posters, such as this one, encouraged people on the home front to do things to contribute to war efforts.

Tonya Foreman: Rosie Riveters were asked to step forward and fill jobs that had been previously done by men who are now on the front lines fighting in the war.

Tonya Foreman: People were encouraged to grow victory gardens to produce food and ease tension and the food supply chain.

Tonya Foreman: So it was into this environment of collective social responsibility that Ancel Keys set out to find volunteers for his starvation study and there was a perfect group of candidates, the conscientious objectors.

Tonya Foreman: JFK said war will exist until that distant day when the conscientious objector enjoys the same reputation and prestige the warrior does today.

Tonya Foreman: Conscientious objectors constituted one fifth of 1% of American men registered for the draft. There were approximately 12,000 total conscientious objectors during World War II.

Tonya Foreman: And, most of them came from historic peace churches, which was a blanket designation that included Quakers, Mennonites, and Brethren.

Tonya Foreman: Because of their religious or personal beliefs, members of this church would not fight on the battle front and didn't believe in killing, they were not draft dodgers, though, but unfortunately they became the brunt of ridicule.

Tonya Foreman: Civilian public service or CPS was an attempt to deal with a troublesome issue of these idealistic pacifist trekkies.

Tonya Foreman: The men of the CPS for unpaid by the government, and they were uncompensated in the event of injury or death, however, some of the piece churches deke of money to the participants families.

Tonya Foreman: Many of their tasks or did meaning, for example, they literally had to move piles of dirt and in this cartoon the caption says, while the shot and shell are flying and the mighty cannons boom, he is tidying up the trenches with a dustpan and a broom.

Tonya Foreman: But some of the things they did were heroic such as parachuting into forests to fight fires. More than 3000 CPS workers volunteered us psychiatric hospitals reported on the horrific conditions they found there.

Tonya Foreman: Some conscientious objectors participated in medical research, for example, 48 CPS guinea pigs, as they were called, were forced to wear lice infested underwear in order to contract typhus.

Tonya Foreman: Others gargled sputum from people with pneumonia other strapped mosquito filled boxes to their stomachs to contract malaria.

Tonya Foreman: Keys performed several experiments on objectors he studied the effects of vitamin both present and absent, he studied the effects of severe cold and severe heat.

Tonya Foreman: He exposed the research participants to excessive moisture he studied the effects of thirst. In 1943 he kept six volunteers in bed for a month to study the effects of bed rest.

Tonya Foreman: And this is an example of a recruitment poster for his starvation study. Keys attempted to appeal to conscientious objectors desires to perform relief work overseas after the war.

Tonya Foreman: Participants given free tuition to university classes and could pursue in a school of foreign relief within a lab where they could learn foreign languages and information that would make them more effective relief workers when the time arrived.

Tonya Foreman: The participants of the Minnesota starvation experiment ranged in age from 22 to 33. Between 200 and 400 men applied. There is conflicting information about that, but far more people applied to be in the study than we're actually accepted to the study.

Tonya Foreman: They were not allowed to be married all men had to have weight that was in certain norms and there were four broad inclusion criteria. Number one, they had to be in good physical health, number two you had to be in good mental health all participants were given an MMPI.

Tonya Foreman: For those of you who are psychologists, you will recognize that the first m in MMPI stands for Minnesota.

Tonya Foreman: Number three they had to have a demonstrated ability to get along well with others under trying conditions and, finally, they were required to have a genuine interest in relief and rehabilitation.

Tonya Foreman: So, in other words, they had to have a personal sense of responsibility in bettering the nutritional status of famine victims.

Tonya Foreman: The average age participant was 25 years old, the average height five feet 10 inches tall and the average weight it was only 152 pounds.

Tonya Foreman: This weight was slightly thinner for their height than the population at large. That wasn't intentional it just turned up with the people who ended up being in this study happened to be rather lean baseline.

Tonya Foreman: Each test subject had at least a year of college nearly half had college degrees their IQ scores were well above average.

Tonya Foreman: On the army's intelligence test the army classification test the research participants score two standard deviations higher than average selective service inductees. So this was a group of bright thoughtful young men.

Tonya Foreman: With regard to informed consent Keys caution each participant about some possible risks, for example, they were warned that their immunity would decrease, and that they would become more susceptible to infectious diseases.

Tonya Foreman: There was a long standing known association between famine and tuberculosis, so all men were warned that they might contract TB.

Tonya Foreman: They were tested for TB prior to the experiment and white man actually did contract tuberculosis near the end of the study.

Tonya Foreman: Participants were told that diabetes was intimately related to the nutritional state and the starvation could increase their risk of developing diabetes. They were told that there could be a least a level of weight loss estimated to be around 40% of body weight.

Tonya Foreman: The outline of this study is that there were three months of starvation, during which each man would be brought to his normal weight for his height and build. After that control phase, there were six months of semi starvation and the final three months were her rehabilitation period. What was life like for study participants?

Tonya Foreman: This is the stadium of the University of Minnesota campus the research participants slept in a large room with two rows of cots and an aisle running down the middle, there was no privacy. One subject Daniel Peacock described it as follows.

Tonya Foreman: The showers we're all one huge line of showers, no partitions or anything and the commodes were all open, there was no privacy anywhere and in a way it's just as well.

Tonya Foreman: Because part of being a guinea pig is that they're going to look at everything that they can look at touch and feel every part of your body in one way or another, at one time or another, for one reason or another.

Tonya Foreman: this is Shevlin Hall, on the University of Minnesota campus it is where the participants a third daily meals originally the study participants were scheduled to eat, at the same time as the football players.

Tonya Foreman: But that schedule was changed because they didn't want the research subjects to fraternize with the football players. Also, can you imagine being on a semi starvation diet and watching football players eat?

Tonya Foreman: Participants were given two meals a day, one at 8am and another at 6pm. On Sundays, they also had a meal at 1245.

Tonya Foreman: The participants were evaluated with multiple tests throughout all phases of the study. Tests included measurement of heart size, total blood volume, hearing and vision tests, and sperm count.

Tonya Foreman: The sperm count was a particular interest in addition to measuring the number of sperm the ejaculates volume was measured as was its viscosity, clarity, and PH.

Tonya Foreman: The speed and aggressiveness of sperm were graded. Participants had to keep mandatory journals which they reported sexual dreams and thoughts.

Tonya Foreman: Other tests included multiple labs, EKGs and tests of strength, dexterity, and endurance. One of the most dreaded parts of the experiment was the treadmill test, during which subjects were pushed to exhaustion.

Tonya Foreman: The participants also had to do 15 hours per week of volunteer work. Examples of volunteer work included helping in the lab, doing maintenance, or working in the laundry.

Tonya Foreman: One potential activity for the study participants was as a volunteer inside Minneapolis this artificial limb factories Minneapolis was and still is an international leader in the prosthetics industry.

Tonya Foreman: During wartime, the need for artificial limbs would have been quite high so you can imagine that, for the conscientious objectors having the opportunity to help make prosthetic limbs would have appeal to their desire to help others.

Tonya Foreman: In addition to 15 hours of volunteer work subjects also had to take 25 hours a week of classes in language, sociology, and political science.

Tonya Foreman: This was the school of foreign relief, a selling point for many participants when they recruited for the project. The goal of these classes, was to learn skills and information that would equip them to travel to Europe and help in post-war relief efforts.

Tonya Foreman: Especially during the standardization phase of the experiment, participants had plenty of energy.

Tonya Foreman: In their limited free time they took advantage of community activities one man ushered in the Minneapolis symphony orchestra, in order to attend concerts for free.

Tonya Foreman: Another man or enrolled graduate level courses at the University of Minnesota someone else acted in a campus production mode year law classes.

Tonya Foreman: The main activity and important requirement of each participant during all phases of the study was walking. Participants were required to walk 22 miles a week at first, they were allowed to walk alone, and however, when there were some rule violations, a buddy system was adopted, the study participants became well known around the campus area.

Tonya Foreman: Participants were allowed to walk outside or on a treadmill. Two men, developed the following strategy.

Tonya Foreman: Roscoe Hinkle and I figured out, we take the 11 mile walk every Sunday night, and then we had half of our walking done and the rest of the week was no problem at all in contrast to some who suddenly on Saturday night are working on the treadmill for hours to get in the time.

Tonya Foreman: Now that we talked about life during the study let's break it down into the three phases. The first part was a three month control phase, the goal was to establish a baseline rate for the men in a controlled setting with a predictable amount of physical movement.

Tonya Foreman: Dr. Keys wanted to determine the number of calories necessary for weight maintenance for each man given a constant activity level. Another goal was to establish baseline values for the various tests that they performed again during the subsequent phases.

Tonya Foreman: The next part of the experiment was six months of semi starvation, the goal was for each participant to lose approximately 2.5 pounds per week.

Tonya Foreman: The amount of food each man received depended on how he was progressing toward his weekly weight loss goal.

Tonya Foreman: Additions reductions to the basic meal plan were usually made in the form of slices of bread and it was easy for the men to see how their meal plan compared to that of your peers. This created some resentment and tension.

Tonya Foreman: It always surprises me to see that the participants in the study, they were allowed to eat slightly more than 1500 calories a day, and it was still considered semi-starvation.

Tonya Foreman: Most of our patients with anorexia eat far fewer calories, often under 1000 calories a day.

Tonya Foreman: Occasionally, I share the information about the study with patients with anorexia and they are always shocked to learn that they are eating, much less than the amount allowed for participants in starvation and study.

Tonya Foreman: Sometimes, I find it provides a helpful fact checking opportunity for patients.

Tonya Foreman: So this is a graph that was made in this study and what's important about this graph, is that there's a point at which people continue to lose weight, even if their caloric input is about the same. So for these men, it turned out, on average, to be about 1500 calories.

Tonya Foreman: This is an example of a sample meal during semi starvation the semi starvation phase meals were designed to approximate the food available in European famine areas with heavy emphasis on potatoes, cabbage, and whole wheat bread was limited.

Tonya Foreman: Here's another sample meal. Each man's weekly meal plan was posted on Friday nights some men dreaded seeing the weekly postings and went to a movie on Friday to delay having to see the bad news.

Tonya Foreman: That their rations were being reduced. Water and cigarettes were allowed in unlimited quantities black coffee was also allowed unlimited initially.

Tonya Foreman: However, as they lost weight, the men derived extreme pleasure from more beverages. They started drinking cups of coffee, up to 15 cups a day therefore coffee was limited to nine cups per day.

Tonya Foreman: For some reason, participants were initially allowed to chew unlimited amounts of gum. One man, James Flower chewed as many as 40 packs of gum per day he chewed and spit so much gum that he measured his gum consumption in a beer mug.

Tonya Foreman: I have no idea why there was no limit on the gum, since that would have contributed to the overall consumption.

Tonya Foreman: Wrigley's gum have been included in many of the military rations and Keys did receive funding from the Office of the Surgeon General, so maybe there was a corporate sponsorship effect.

Tonya Foreman: That's complete speculation on my part, but I've always found it puzzling, that the chewing gum was allowed in this study.

Tonya Foreman: Before we talk about specific study findings, I want to point out that, not surprisingly, many of these findings are also what we see in patients with anorexia.

Tonya Foreman: It stands to reason that the physiological effects of starvation will be the same, regardless of etiology.

Tonya Foreman: I find it fascinating though that some of the emotional and behavioral effects are also the same.

Tonya Foreman: I believe that a certain point and starvation physiology kicks in and affects behavior. So some of what we consider to be eating disorder behaviors or symptoms may simply be secondary to physiology.

Tonya Foreman: During the starvation phase, the basal metabolic rate dropped by as much as 50% the pulse dropped sometimes to as low as 30 or 40, the lowest recorded pulse was 28.

Tonya Foreman: Subjects developed low blood pressure, dizziness, and fainting spells. They had frequent urination and constipation and they became hyper focused on bodily activities such as urination or desiccation.

Tonya Foreman: The blood work of the subjects show decreased red blood cells. Their white blood counts decreased by up to 30%. Their nails and hair fell out or grew slowly.

Tonya Foreman: Cuts and bruises healed more slowly. The subjects developed thin, rough skin. They felt weak and also had edema. Some experienced ringing in their ears and dizziness. Study participants experienced profound fatigue. One man, Sam Legg said,

Tonya Foreman: "I was walking along with my buddy, it was deep into the semi starvation and we were tired. We would look for driveways when we got to across street so we wouldn't have to walk up one step to get from the road to the sidewalk.

Tonya Foreman: And so we would walk in the gutter for a while looking for a driveway, we were tired and weak, and so we were standing at a corner waiting for light or something and a kid came along on a bicycle and he was really moving pumping.

Tonya Foreman: And I looked at him and said, 'wow look at that boy he's really whizzing' and then I said to myself, I know where he's going he's going home for supper and I'm not."

Tonya Foreman: And then, for very brief, I hope, it was brief moment I suddenly hated the boy. I hated at this point to remember with horror, I could feel such a thing so utterly irrational, but there it was.”

Tonya Foreman: In the diary entry from another participant he wrote about going to a department store with a revolving door. He was too weak to push the door open so he had to wait for someone to accomplish it for him.

Tonya Foreman: He was also too weak to open the doors to the library he had to “wait until somebody let me scoot in after.”

Tonya Foreman: Subjects developed an increased tolerance for hot food and beverages. They wanted their food heated to high temperatures. This reminds me of what we see with patients being treated for restrictive eating disorders.

Tonya Foreman: They're often obsessed with hot drinks, especially tea and sometimes they become very particular about the temperature at which their food is served. The research subjects spent time lying in the sun.

Tonya Foreman: At an eating disorder center where I currently work patients often lie on the pavement with their arms and legs spread out to maximize the sun exposure.

Tonya Foreman: And they call this star fishing. It makes me nervous because I worry about sunburn and dehydration but many patients are drawn to the pavement to soak up the warm.

Tonya Foreman: Some of the research subjects wanted hats, gloves, and blankets. They wore multiple layers of clothing to stay warm.

Tonya Foreman: Think of your patients with anorexia, they often wear multiple layers. I keep blankets in my office because patients are always cold. They wear sweats during the North Carolina summers. I'm sweating and they are freezing. Some of the participants took up smoking.

Tonya Foreman: This is the dexterity test. During the starvation phase, cognitive abilities decreased, people had poor concentration, they had more trouble sitting through the required classes, they reported sleep problems.

Tonya Foreman: Subjects had to repeat the MMPI several times during the experiment, most of them had higher deviations on the neurotic scale after six months of starvation than they did at the beginning of the study and these in MMPI changes have been called semi starvation neurosis. The participants had decreased libido and fewer erections.

Tonya Foreman: And what about all the sperm that were studied? Their motility decreased, and they could not swim as long. There was a buddy system for all activities, due to a risk of cheating.

Tonya Foreman: Therefore, anybody who wanted to go on a date had to take a buddy with them. Fortunately everybody's libido took a nosedive and interest in dating declined.

Tonya Foreman: A participant named, Harold Blickenstaff said, "if you went to a movie, you weren't particularly interested in the love scenes but you noticed every time they ate and what they ate." Although none of the participants had eating disorders prior to the study they became preoccupied with food.

Tonya Foreman: They developed behaviors that we also see in patients with restrictive eating disorders, for example, some men became obsessed with cookbooks and food. By the end of this study one man had accumulated nearly 100 cookbooks; some even planned to open a restaurant after the study ended.

Tonya Foreman: Several newspapers became interested in the research study. An article in the Minneapolis Star Journal told of an incident in which one of the research subjects was, "walking past the bakery and was so tempted by the rich odors wafting from the place, that he rushed in and bought a dozen donuts. He gave them to the children in the street and watched with relish as they ate them."

Tonya Foreman: The participants developed unusual behaviors at the table, plate licking became common. Some men held their food and coddled it like a baby.

Tonya Foreman: They tried to prolong meal times, for example, they diluted their mashed potatoes with water to make it seem like more food that took longer to eat. They call this practice souping.

Tonya Foreman: They drenched everything in water to increase the volume and this also led to excessive urination. They held their food in their mouth for long periods of time. They started eating the components of their meals and rigid order.

Tonya Foreman: One day, a dignitary came to visit the subjects and have a meal with them. A green pea fell onto the floor, even though they had a distinguished guests, a conscientious objector dropped to the floor picked up the pea and ate it without missing a beat.

Tonya Foreman: Many men became obsessed with salt. One man, Samuel Legg developed a habit of heaping all the food on his plate into one pile. He then salted and peppered it until it was crusty with seasoning and then he ate it.

Tonya Foreman: The study participants were aware of their unusual table behaviors. One wrote, 'several of us got talking about how people play with their food, men paw at the food, shove it from one side of the plate to the other, spend gobs of time making sandwiches continue to jump up and down, fixing this and getting that.'

Tonya Foreman: If you have ever eaten a meal with a patient with anorexia nervosa this description sounds very familiar. Several men tried to distract themselves from thinking about food by taking up new hobbies including collecting and hoarding books, clothes, and trinkets. One man wrote,

Tonya Foreman: 'I've been wondering just why I want to buy books so much lately. I've always liked to look at books, but now I seem to want to go farther and actually acquire them.

Tonya Foreman: I find I'd like to buy clothes too, some things that I really don't need. Not being able to buy food whenever we want to may have something to do with this.' Many subjects became irritable as starvation progressed. A participant named Marshall Sutton observed,

Tonya Foreman: “we were impatient waiting in lines if we had to, and we get disturbed with each other's eating habits. At times, I remember going to a friend at night and apologizing and saying, ‘Oh, I was terrible today, and you know let's go to sleep with other thoughts in our minds.’” This is Sam Legg. As the steady progressed, he started demonstrating unusual behavior.

Tonya Foreman: He started collecting cookbooks and reading recipes. He stared at pictures of food with pornographic interest; he was agitated in the meal lines.

Tonya Foreman: When a cafeteria worker dropped her serving spoon and had to go back to the kitchen to get another one, Legg started smashing his tray on the counter swearing. Legg had previously been an unofficial leader of the group and the other subjects became worried about his deterioration.

Tonya Foreman: Loneliness and isolation are major consequences of starvation, as people become more obsessed with food, other interests or relationships suffer. As Harold Blickenstaff, a participant in the Minnesota study put it,

Tonya Foreman: “I don't know many other things in my life that I look forward to being over with any more than this experiment. And it wasn't so much because of the physical discomfort but because it made food, the most important thing in one's life.

Tonya Foreman: Food became the one central, and the only thing really in one's life and life is pretty dull if that's, the only thing.”

Tonya Foreman: Every time I have a new patient with an eating disorder, I ask him or her what they like to do for fun. More times than not the patient responds by saying I don't know or they identify something they used to like to do, but no longer enjoy. Food restriction robs people of all the other important aspects of life.

Tonya Foreman: From a chronological standpoint, the war in Europe ended in May 1945, at the beginning of the 13th week of starvation.

Tonya Foreman: Although this was great news for the world, it did not allow Ancel Keys time to complete his study in order to coincide with the release of prisoners from concentration camps.

Tonya Foreman: And that negatively affected the morale of the research subjects. They had been motivated to enroll in the study to help efforts after the war, but the war in Europe ended, while the subjects were still starving.

Tonya Foreman: Several times the men were asked to complete an inventory of 50 complaints. As Keys and his assistance attempted to quantify the misery of the subjects. As the study progressed, the average number of complaints rose from 6.6 to 15.

Tonya Foreman: Tiredness, decreased libido, and decreased comprehension were among the most frequent complaints. In order to boost morale, Keys allowed a feast meal during the 15th week of starvation.

Tonya Foreman: The men voted on the items and the meal included grapefruit juice, bacon, gravy, biscuits, ham, bread with butter and honey, and an orange. The meal provided 2366 calories. The atmosphere at the meal was happy and light hearted.

Tonya Foreman: However, at the end of the meal, the men realize that they would have to starve again. They looked at their plates and could not bear to leave one edible item on the plate, all that remained was an orange peel.

Tonya Foreman: Each man picked up the peel and ate every bit of it he's was furious when he found out because the peel had not been part of this caloric calculations.

Tonya Foreman: Despite being angry about the orange peel, Ancel Keys worried about how the study was affecting the subjects. One participant reported,

Tonya Foreman: "Mrs. Keys reported that Dr. Keys went through terrible times during the experiment, as we lost weight and became gaunt and so on, and he would come home and say, 'what am I doing to these young men? I had no idea, it was going to be this hard.'

Tonya Foreman: Here's Dr. Keys measuring the chest of James Plaugher. Plaugher was eventually thrown out of the experiment for cheating.

Tonya Foreman: When he didn't lose the expected amount of weight, Plaugher was confronted about cheating. He finally admitted that he ate a sandwich he found on the ground, stole a student's lunch and ate it, and had been eating garbage routinely.

Tonya Foreman: Another man who was removed from this study was Franklin Watkins. Before the buddy system was implemented, he cheated by eating ice cream and rutabagas. He was disturbed by dreams about cannibalism. His money was taken away so he couldn't purchase extra food, so he started shoplifting food.

Tonya Foreman: He started challenging the experiment during conversation with peers. He asked, "what are we really accomplishing here?" He was confronted by Keys, he started crying and said he was a failure. Then he said he was going to kill himself and he threatened to kill Keys. He was taken to the psychiatric ward of the university's hospital.

Tonya Foreman: Keys was not sympathetic. He wrote in the chart that Watkins was, "a bisexual with poor personality integration and weak self-control."

Tonya Foreman: The diagnosis of bisexuality was based only on an MMPI results and Watkins' earlier admission that he had once had a beautiful friendship with a man years before.

Tonya Foreman: This is Henry Scholberg and he successfully completed this study. In fact he's the subject to acted in a movie or play during the experiment.

Tonya Foreman: Scholberg feared that his hunger and decreased concentration would cause him to flub his lines. In reality, he delivered in French, a convincing performance his lines included the following,

Tonya Foreman: "Ever her alone in my thought she has all my devotion, all my desires, all my joy, I speak only of her, I breathe only for her, and here is the fit reward for so much love."

Tonya Foreman: As he received applause, Scholberg was not dreaming of a lost romantic love, he had been thinking of fresh bread, blueberry pie, and curry dishes.

Tonya Foreman: Here's Sam Legg again, he was in the rehabilitation phase, but still had his food controlled. The week before he had dropped a car on his hand while he pretended to do some maintenance. He crushed a finger doctors were suspicious that allowed him to remain in this study.

Tonya Foreman: He befriended some elderly women during one of his walks. He went to visit them one day, but they were eating he couldn't eat the meal, but he enjoyed the company.

Tonya Foreman: While they ate, he went outside to chop wood. He was chopping wood and heard people laughing and scraping plates inside. He imagined slicing through meat.

Tonya Foreman: As he chopped the wood he put his left hand on the flat top of a log and cut off three fingers. When he got to the hospital, he told the staff member at the hospital, he was in his starvation study and she said, 'but, but you didn't have to do it that way.'

Tonya Foreman: According to Legg she thought I'd eaten them. I was hungry I didn't actually they're now buried in the backyard in Minneapolis.

Tonya Foreman: Keys went to see Legg in the hospital to kick him out of the study.

Tonya Foreman: Legg begged to stay in this study and said, "Keep me in it, for the hungry. For the rest of my life, people are going to ask me what I did during the war.

Tonya Foreman: This experiment is my chance to give an honorable answer to that question." He was allowed to stay in the experiment and his rehabilitation phase meals were brought to him in paper Chinese food boxes.

Tonya Foreman: When asked whether the incident had been an accident or not, Legg said he could not say that it was, and he could not say that it wasn't. After six months at semi-starvation participants entered into a three month rehabilitation.

Tonya Foreman: Initially there was a period of restricted rehab during which subjects were split into several groups and given different meal plans to determine the best rations to use for refeeding.

Tonya Foreman: The information from this part of the study is not particularly helpful because the calories were still fairly low approximately 2200 calories in the lowest group.

Tonya Foreman: And there was not much difference in each group's meal plan. Keys recognized that people needed more calories than expected to begin to gain weight, therefore, he deviated from his plan and increased the meal allowance by an average of 800 calories per group.

Tonya Foreman: At a conference in 1945, Keys said, "enough food must be supplied to allow tissues destroyed during starvation to be rebuilt." "Our experiments have shown that in an adult man, no appreciable rehabilitation can take place on a diet of 2000 calories a day.

Tonya Foreman: The proper level is more like 4000 daily for some months the character of the rehabilitation diet is important also but unless calories are abundant than extra protein vitamins and minerals are of little value."

Tonya Foreman: Most of the men participated in the controlled rehab phase that lasted for 12 weeks. At the end of 12 weeks, the mean BMI of the participants was 18.4 which was still well below their baseline weights. After the 12 week control rehab most participants left but 12 stayed for another eight weeks to be monitored while they ate without restriction.

Tonya Foreman: Most men reported still feeling hungry after eating. One participant, Henry Scholberg had to be taken to the hospital to have his stomach pumped because he ate so much.

Tonya Foreman: Another man threw up on the bus. He ate and ate but could not get full his stomach was like a bottomless pit.

Tonya Foreman: During the first two weeks of unrestricted refeeding most men ate up to 11,000 calories of food per day. In fact, they ate so much that Keys reinstated some dietary

limits. The extremely high appetites lasted for a few weeks for most participants and then their intake leveled off to around 3200 to 4500 calories per day.

Tonya Foreman: Once the subjects were given liberal access to calories, the participants gained weight rapidly, but they gained body fat more rapidly. The takeaway message was that fat goes back on before muscle therefore people needed to gain even more weight to rebuild muscles in organs.

Tonya Foreman: To summarize, body fat drop significantly and rapidly during starvation and fat came back on first during refeeding. At eight months follow up, the abdominal body fat was 40% higher than pre-study and then it started dropping.

Tonya Foreman: The further out from the end of the study the less valuable the data is because it was not available for all participants. A year after the study ended weight data was only available for eight men.

Tonya Foreman: Their body fat was still somewhat above their baselines. Most of the subjects ended up being heavier than their baselines for more than a year on average, they weighed on hundred and 16% of control weights a year after the study.

Tonya Foreman: Three men never returned to their baseline weights.

Tonya Foreman: This raises the question of whether the body might increase its set-point after starvation.

Tonya Foreman: So, think of yo-yo dieting. People restrict and then they eat and they gain fat and then they restrict and they eat and they gain more fat and they restrict. Each time they may end up with more body, fat and less lean tissue.

Tonya Foreman: In October of 1945 Keys published a 48 page report entitled Experimental Starvation in Men. At the time of the reports publication, the men were just in the rehabilitation phase, so there wasn't much practical information that Keys could provide for the World War II relief workers.

Tonya Foreman: Keys did some specific investigation on anorexia nervosa. He obtained the 1895 autopsy of a 16 year old girl who weighed 49 pounds when she died from anorexia.

Tonya Foreman: Keys observed that the Minnesota starvation experiment actually more closely duplicated anorexia than war time starvation, because in anorexia, conditions other than food intake such as cleanliness and accessibility to medical care, were normal.

Tonya Foreman: When given what it needs after starvation, the body stores fat first and then builds muscle. Therefore in treating anorexia, people's weight might need to be restored above pre-starvation weight in order for full repair of muscles and organs.

Tonya Foreman: Keys said that the most significant finding of his study was that the human body is well equipped to deal with starvation and that is extremely resilient. He thought that the body was more able to tolerate the effects of starvation, than the mind is.

Tonya Foreman: It was hoped that there might be an optimal blend of nutrients that would help a person recover from starvation. What Keys learned, however, is that no protein or vitamin supplement makes much difference on the rate or degree of recovery.

Tonya Foreman: In protein deprived situations, a protein supplement might be helpful, but basically according to Keys.

Tonya Foreman: The relatively high cost providing special protein feedings as compared with the cost of supplying additional calories far outweighs any possible advantage. He continued, "Calorie intake is the single nutritional element of highest importance in rehabilitation feeding a person's starved on a European-type of famine diet, so, in other words, food is the best way to refeed someone who has been starving."

Tonya Foreman: Relief workers were also prepared to treat concentration camp survivors with nasal gastric tubes or IV fluids.

Tonya Foreman: Based on a belief that their digestive tract would be too deteriorated to function properly. But Keys demonstrated that using the digestive tract was best, he said, "the

vast majority of the famine victims could take nourishment my mouth, without any special difficulty.”

Tonya Foreman: And this is what we know about treating patients with anorexia unless there is a medical reason that prohibits the use of the GI tract refeeding can be done by mouth. NG tubes are generally not necessary.

Tonya Foreman: This was published in 1950, it is a huge two volume summary of the starvation experiment.

Tonya Foreman: And here's the citation for it.

Tonya Foreman: So what happened to our friend Ancel Keys? He went on to have a productive scientific career and most of his fame had nothing to do with the Minnesota Starvation Experiment.

Tonya Foreman: Here, he is on the cover of Time Magazine in January 1961. The article discussed Keys novel theory that cholesterol is linked to heart disease, but mentions nothing of the starvation experiment.

Tonya Foreman: Keys became a proponent of the Mediterranean Diet and was the author of The Seven Countries Study. The study looked at the diets and coronary health of residents of European countries with low rates of cardiac disease.

Tonya Foreman: Keys wife Margaret was his longtime collaborator. They co-authored three books, two of which were best sellers they have three children. One child is a psychologist, another is a cancer researcher, and his third child, Martha, was killed by a robber in 1991 at the age of 42.

Tonya Foreman: Ancel Keys died in November 2004 at 100 years old.

Tonya Foreman: If there are heroes in this story, it is these men. These are some of the participants in the Minnesota starvation study.

Tonya Foreman: After the experiment was over, many of them went on to have distinguished careers serving others. Seven of them participated in Heifers for Relief, a program that delivered livestock to post-war Europe.

Tonya Foreman: The volunteers care for the animals during the boat journey across the Atlantic Ocean. Samuel Legg worked with the American friend's service committee to raise money for food to be sent to Germany.

Tonya Foreman: He also spent time in France and Switzerland with the Quakers. A participant named Robert McCullough went to Yale divinity school and then worked on campus ministries.

Tonya Foreman: Robert Villwock went to the University of Chicago Divinity School and William Anderson became an ordained Minister working in South Africa, Mozambique and Kenya.

Tonya Foreman: Max Kampelman had a career in diplomacy and headed the US delegations to the Geneva negotiations on nuclear and space arm reductions in 1974. Other participants became professors and teachers.

Tonya Foreman: Could the Minnesota Starvation Experiment be conducted today? Some might argue that its risks were unknown, since the subjects could not give true informed consent.

Tonya Foreman: But that's always true to some extent with research. Some might argue about the quality of consent, since all of the participants had been compelled by the selective service to do something. And they chose to enroll with the civilian public service, however, there are many alternative activities they could have done in the CPS.

Tonya Foreman: Years after the experiment ended the test subjects almost always said they would volunteer to do it again. Wesley Miller reported, "It's colored my whole life experience and it was one of the most important things I ever did."

Tonya Foreman: I will leave the last words to Sam Legg, the man who cut off his fingers. "I think probably most of us are feeling we did something good and we're glad we did it and that helps us live a better life."

Tonya Foreman: If you're interested in learning more, I highly recommend this book it's well researched has many colorful details reads like a novel and is the source for much of the information in this presentation.

Tonya Foreman: And then, here are a couple of other references that were quite useful as I was preparing these slides.

la-shell_johnson@med.unc.edu: Thank you so much, Dr. Foreman for that presentation.

la-shell_johnson@med.unc.edu: Now we will open up for questions that were posed by the participants in today's webinar as a reminder, we will send the evaluation and the slides from today's presentation tomorrow morning, and any unanswered questions will be sent to you by email within one week from today. So the first question we have is, is there a hypothesis for why the preference for hot beverages thermal regulation something else?

Tonya Foreman: Um I don't know if Keys had a hypothesis.

Tonya Foreman: I think patients are cold and it makes them feel warm although,

Tonya Foreman: And I'm not speaking now with regard to the study I'm just speaking as a result of working with patients with eating disorders for so long.

Tonya Foreman: People with eating disorders tend to develop interesting relationships with fluids. Sometimes they restrict their fluids, but sometimes they drink excessive amounts of fluids, just to kind of fill up.

Tonya Foreman: There's also on the pro-anorexia websites, there are all kinds of tips and tricks and one of them is to have very hot food or very hot drinks to speed up your metabolism this, this is not scientifically based, this is just lore on those.

Tonya Foreman: Sites, sometimes people do it for the caffeine, because it gives them energy, but if I had to try to make a scientific hypothesis, I imagine it's just simply because they're so very cold and just can't get warm.

la-shell_johnson@med.unc.edu: Thank you so much for that response Dr. Foreman. The next question is it helpful to share this study with patients who have eating disorders?

Tonya Foreman: I've done it sometimes very carefully and I would never do it with somebody I don't know well. I would only do it if we had been working together for a while and had a good relationship, and that I thought that sharing the information would kind of help them with some fact checking.

Tonya Foreman: You know I gave you a trigger warning at the beginning of the talk, looking at the photographs are disturbing and so, if I talk to a patient about the study—I work in a residential setting in an Inpatient setting.

Tonya Foreman: I always ask them not to go talk to their peers about it because the last thing I want to do is walk into the mill you and see people with pictures of the Minnesota starvation study pulled up on the computer because the photographs and some of the information in the study could be very upsetting to people, but for the right patient, I think, sharing with them, the fact that 1500 calories is what was permitted in a semi-starvation study can be rather helpful.

la-shell_johnson@med.unc.edu: Thank you so much again Dr. Foreman. The next question states.

la-shell_johnson@med.unc.edu: “Thank you for sharing this in detail, is there any possibilities to read about this study in the details like you gave us?”

Tonya Foreman: Yes, that Todd Tucker book.

Tonya Foreman: The Todd Tucker and the.

Tonya Foreman: This one, The Great Starvation Experiment is just filled with juicy details that talk about the history of the time, and about some of the men.

Tonya Foreman: And then the citations that I gave also refers some information that was gathered I think 57 years, maybe after the study was over, they were able to contact, many of the study participants who were still alive and they interviewed them and so some of the quotes came from the recollections of those men.

Tonya Foreman: I don't know what happened to all the diaries all the participants had to keep diaries during this study I would love to know where those are.

Tonya Foreman: As far as I know, there's no museum or necessarily an archive or anything, but if you go on YouTube there are also a few.

Tonya Foreman: YouTube videos about the Minnesota starvation study and I think there are a few clips of some of the participants in their later years talking about what it was like to be in the study.

la-shell_johnson@med.unc.edu: Okay, thank you once again Dr. Foreman. The next question asks, "How is this study informing treatment of bulimia and binge eating disorder, in addition to anorexia?"

Tonya Foreman: I don't know specifically how it would form bulimia, I think for binge eating disorder it really reinforces that when we try to restrict what we eat.

Tonya Foreman: The body does kind of keep track of that and it will come back even sometime later and try to have us make up for what we didn't get.

Tonya Foreman: So for people with you know binge eating disorder or people who have eating disorders where they restrict most of the day, and then they binge later in.

Tonya Foreman: The day you know, I think it does demonstrate that the body does try to get its nutrition, even if it comes out in and out of control form.

Tonya Foreman: I think probably the most important takeaway from this, though, is that fat comes back on first and if you've ever worked with patients who are undergoing a nutritional rehabilitation process, they may develop what we sometimes call a refeeding tummy.

Tonya Foreman: You know, the fat the abdominals that is often the first thing that comes back on.

Tonya Foreman: And that seems sort of like a cruel trick of nature, because that's probably the one part of the body that's the most distressing for people, and there have been times when patients have developed a refeeding tummy and we do talk about it because.

Tonya Foreman: it's truly there and I think sometimes it is important to be honest with patients because as they develop insight they realized that their perceptions about their body are not accurate.

Tonya Foreman: And if they have a refeeding tummy and they come in and say, "look at my belly, it's sticking out" if it is a refeeding tummy, sometimes I have said to patients.

Tonya Foreman: "You know, there is this physiological thing that happens for people sometimes." So I think probably the main applicability to all the eating disorders from this study is what it teaches us about the physiology of starvation and how the body later compensates and may reset the set point.

la-shell_johnson@med.unc.edu: Thank you so much, Dr. Foreman and we have two questions left, but since we're at time, I just wanted to reiterate, we have a few folks that are asking for the name of the book and the citation and we'll be sure to include.

la-shell_johnson@med.unc.edu: Those in the email, and I have Dr. Foreman is sharing it right now so we'll be sure to include the name and the title, along with.

la-shell_johnson@med.unc.edu: The references that Dr. Foreman shared in today's presentation, with the email that we send tomorrow. Thank you once again for your time, Dr. Foreman. This presentation was truly great and we thank you for joining.

Tonya Foreman: And thank you all for joining today.

la-shell_johnson@med.unc.edu: You're welcome. Bye.