

## THE MINNESOTA STARVATION STUDY

In a discipline with many curious—even odd—studies, the Minnesota Starvation Study ranks among the most unusual. Begun in 1944, toward the end of World War II, the study had very practical goals. As the war was nearing a close, it was known that many individuals in war-torn countries, as well as prisoners of war, had lived for long periods under conditions approaching starvation. What was the impact of food deprivation on these people, both physically and psychologically? What kind of behavior could be expected from them after the war ended? And, most important, what would be the best treatment to bring these nutritionally deprived individuals back to some level of normality?

It was hoped that the proposed research might even provide answers for more general and far-reaching questions. The history of the world has been marked with famines. An uneven food supply is ever present. And yet there had never been a systematic study of the effects of food deprivation. The study had the potential to yield vital information about a phenomenon tied to one of the most basic features of human existence.

Rather than trying to answer their questions theoretically, the researchers proposed to answer their questions empirically. Thirty-six male volunteers agreed to be put on a diet of very limited calories—about half a normal diet—and be closely monitored. All of them had been conscientious objectors to the war, and although they had been against the war itself, most were not only willing to participate in the experiment, but they were also eager to do so. Some of them felt guilty for not being involved directly in the war. Most of them considered their participation in the experiment as a way to demonstrate their loyalty to their country despite their refusal to join directly in the war. Also, many of the volunteers were genuinely altruistic and were more than willing to participate in an experiment that might provide a larger benefit for mankind (Tucker, 2006).

Some possible effects of severe food deprivation were already known. One of the most dramatic instances in the United States involved the famous Donner Party wagon train expedition in the winter of 1846 to 1847. After being stranded in the Sierra Nevada mountain range near the California border during a particularly

harsh winter, some members of the group resorted to cannibalism to survive, an outcome that many find shocking even today. But similar degrees of food deprivation had developed in several European countries during the war, notably in Leningrad during the famous siege beginning in 1941. Millions of people were believed to have starved to death in Leningrad in this period, with many horror stories emerging in its aftermath.

The Minnesota study was carefully planned, with virtually every aspect of the volunteers' behavior monitored for a year. It was a unique study and one that would likely never be replicated for several reasons. The combined circumstances of the war and the pacifist inclinations of a segment of the citizenry provided the subject pool, a committed group that would be difficult to duplicate. There would also be ethical considerations to take into account.

At the time the study was conducted, human experimentation was common and ethical standards for research with human subjects were vague. Some of the increased sensitivity to human experimentation would grow out of the war when accounts surfaced of horrific experiments by both the Germans and Japanese. Modern interpretations of research ethics would likely not permit the kind of subject manipulation employed in the study.

Nonetheless, the climate of the times permitted the study to take place, yielding results that were both helpful and surprising. Several of the results pertained to phenomena that had not been originally proposed for study, such as eating disorders.

## BACKGROUND OF THE STUDY

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The chief investigator for the study, and the person who conceived of it originally, was Ancel Keys (1904–2004), a bright, energetic health researcher with an impressive background and series of accomplishments. (Keys was a participant in the Terman “gifted study” discussed in Chapter 16.) Although he had held a variety of appointments, at the time of the study he was the director of the Laboratory of Physiological Hygiene at the University of Minnesota, a position he would retain for the remainder of his professional life. Not only did Keys hold two doctorate degrees, he was the primary inventor of K rations, the staple food of many soldiers during the war. Despite the jokes about them, K rations were devised to be compact, portable, attractive, and nutritionally sound sources of food. By most objective standards, they succeeded on all counts.

Among the other researchers in Keys's laboratory who played a crucial role in the research was Josef Brožek (1914–2004), a Czechoslovakian-born psychologist who obtained a doctorate degree from Charles University in Prague in 1937. Brožek, who had only been in the United States a few years when the study began, was the chief psychologist for the study.

Due largely to his success with developing K rations, Keys was approached by the U. S. Army to solve other problems it faced regarding issues of health and nutrition. He conducted several studies for them including research on vitamin deficiency and the effects of temperature variations. When the idea for the starvation study occurred to Keys, he realized immediately that one of the most important elements was securing an appropriate subject pool. The Civilian Public Service (CPS) camps, overseen by the military, seemed a particularly good source, and it was not hard to convince the military of the need for the new study. The CPS camps were composed mostly of pacifists with both religious and personal objections to war. The funding for the study would come from a variety of sources, including church groups, commercial companies, and the University of Minnesota.

## THE PROPOSED STUDY

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Keys envisioned the study as divided into three parts. For the first 3 months, the volunteers would be on a regular diet. Their specific caloric needs would be evaluated, and their normal weight determined. These data would provide a baseline for the remainder of the study. In the second phase, lasting 6 months, the participants would be fed an individualized diet consisting of roughly half their normal caloric intake. The goal was to reduce their weight by approximately 25% during the 6-month period. Keys estimated that such a loss of weight would provide the kind of information required for the study, would not endanger the health of the volunteers, and was realistic. The third phase of the study, lasting 3 months, was the recovery phase. The volunteers would be divided into groups and fed according to several tracks, consisting of different levels of calories and food elements, such as protein and carbohydrates. The goal in the recovery phase was to determine which of the recovery methods produced the best results.

## THE VOLUNTEERS

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Keys prepared an elaborate brochure for the recruitment of subjects. In it, he wrote of the benefits to mankind in general that might flow from the research, accurately predicting that such an appeal would be popular among the CPS members, many of whom were highly idealistic. Large groups of CPS members had been working in forestry camps or mental hospitals, with varying degrees of satisfaction. Many felt they were involved in “busy work.” More than two hundred responded to the call from Keys. He was careful making the final selection, recognizing that the selection of volunteers was crucial to the success of the experiment.

Several researchers from the laboratory were sent to CPS camps to evaluate the volunteers. Keys insisted that the participants in his study be in good physical and mental health. The latter was measured by a new psychological instrument, an

inventory called the Minnesota Multiphasic Personality Inventory, or MMPI for short. It had been created only a year or so before, but it would eventually become one of the most important and popular of all the objective personality tests. The inventory consisted of more than 500 items, many of them seemingly benign. It was structured so that the individual completing it would be compared to others with known mental health issues. The final scoring would provide a chart depicting ten different mental health categories with a score on each for the subject.

Keys also insisted that all the subjects chosen should be single and able to get along with others. He felt that married subjects might have too many conflicts as the study progressed. Finally, he wanted subjects who were committed to the goals of the experiment and were likely to see it through to the end. Keys correctly anticipated that the latter stages of the second stage would prove very difficult.

Thirty-six volunteers were eventually selected, all male, between the ages of 20 and 33. In addition to meeting the initial criteria, it turned out they were well educated and considerably more intelligent than the general population as determined by several objective measures. Keys knew that he had not chosen a random sample of participants, but there were other considerations that overrode the need for such a sample. He recognized that he was experimenting with human beings, a sensitive issue for him. There were dangers associated with the experiment, both physical and psychological. He was careful to explain the dangers to his subjects as best he could. At the same time, he realized that despite his planning, he was entering unknown territory.

## THE STUDY BEGINS

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The volunteers assembled for the beginning of the experiment at the University of Minnesota in mid-November 1944. Their primary venue was the large warren

of rooms underneath the stands of the university stadium. It was also the site of the Laboratory of Physiological Hygiene run by Ancel Keys. Here they would sleep and participate in many of their tests. Their food, very carefully monitored, would be provided in a cafeteria especially set aside for them in another part of the large campus.

Wallace Kirkland/The LIFE Picture Collection/Getty Images



► **Image 17.1** Minnesota Starvation Study participants

In the initial days of the research they were subjected to a variety of tests, with a particular focus on body weight and fat content but also on their sense acuity and stamina. Their food, which most of them found appetizing and more than adequate, was calculated to find the precise level for each individual at which body weight would be maintained. They were instructed to engage in walking several miles each day for a total of 22 miles a week. Daily activities were organized for all of them, based on individual talents and interests. A few volunteers with scientific backgrounds worked with the researchers to analyze data from the study. Other volunteers attended regular classes at the university. Some with special talents or abilities offered classes to the other volunteers. All things considered, it was an easy 3 months. But they knew it would not last.

## SIX MONTHS OF STARVATION

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The second phase of the experiment began on February 12, 1945, approximately three months after the initial evaluations. Available caloric intake was reduced to slightly more than 1,500 calories a day, roughly half the calories available during the first phase. The diet was constructed to resemble the food available to citizens of several war-torn countries, consisting of large portions of potatoes and cabbage and minimal amounts of meat. Macaroni and cheese was one of the most popular meals, but its calories were limited and portions strictly controlled. Whereas three full meals were available in the initial phase, now the participants had only two meals—breakfast and an evening meal. The volunteers were allowed unlimited access to black coffee and water and were supplied with a daily quota of cigarettes.

During the initial weeks, there didn't seem to be any great difference in the behavior of most of the volunteers. They marveled at their weight loss, particularly noting the way their clothes no longer seemed to fit. There was some loss of strength, but their mood was generally good. However, there were wide individual differences. A book on the study by Tucker (2006) contains many case studies which illustrate the variety of responses. Tucker points to one subject, for instance, who began cheating on his food intake only a few weeks into the second phase of the study and soon gave evidence of psychotic behavior. After he was hospitalized and returned to a regular diet, his mental symptoms disappeared. Not surprisingly, he was dropped from the study. However, as a result of his behavior, the remaining volunteers were closely scrutinized for possible cheating.

Keys laid down new rules that prohibited the participants from attending any activities on their own. They were required to find another volunteer who would accompany them, whether it was to a university class or even on a date. Despite much grumbling, the volunteers complied. But larger issues began to present themselves.



► **Image 17.2** A volunteer in the second phase of the study

The food deprivation was beginning to show up in other, often unexpected, ways besides loose-fitting clothes. Food became the central focus of the lives of the participants. Whether they were reading a magazine or looking at a movie, any reference to food became a source of immediate interest.

The volunteers began to have food related dreams. They developed odd eating patterns. Plate licking was common. Other parts of their lives began to change as well.

Several of the men had been dating, but their interest in dating—and any potential sexual activity—was one of the first things to disappear. Among the subjects who had pursued classes and other cultural activities, their interests in such activities were significantly diminished. Classes run by the volunteers came to a halt. The subjects were easily irritated and seemed to care less what their fellow volunteers thought of them. As the second half of the starvation phase began, other physical symptoms appeared. Participants were constantly cold, and their body temperature and pulse rate dropped. Keys concluded that their bodies were trying to conserve as much energy as possible.

Sitting became uncomfortable. They no longer had the padding afforded by normal weight. Fighting off food-related urges was a constant battle. The MMPI recorded significant increases in depression, hysteria, and hypochondriasis. Some participants thought they were on the brink of madness. Their odd and antisocial behaviors became even more pronounced. Another volunteer admitted to cheating, and before a final decision was made, he developed a physical condition that required him to be dropped from the study. The subject pool was down to 34. Two more subjects were dropped because of known or suspected cheating. They simply had not lost the weight they should have if they had been observing their diets. When the final day of the starvation phase arrived near the end of July, there were 32 subjects left in the pool. As a group, they had lost 24% of their initial weight, very close to the value Keys had sought.

## THE FINAL PHASE BEGINS

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The last phase of the study was labeled the “rehabilitation phase,” but it was not the food-filled extravaganza that some participants had hoped for. Instead, it consisted of the remaining subjects being divided into four groups, with each group receiving the same kind of foods they had received earlier but with an increase in calories. The lowest group received a 200-calorie-per-day increase; the highest group received an 800-calorie increase. The changes were meager by any standard and the recovery reflected that. Weight gains were very small and slow in coming. The men became more antagonistic and troubled than at any time during the experiment. One man chopped off three of his fingers while cutting wood, and there was a strong suspicion that he had done it purposely. Even he was not certain if he had done it on purpose. Whether it was an accident or not, Keys was prepared to drop him from the study. However, the subject made an impassioned request to be retained and Keys allowed him to remain (Tucker, 2006).

After consulting with his fellow researchers, Keys decided to deviate from the initial plan and increase the calories substantially. The men went back to three meals a day, at a level resembling a more normal diet. The requirement that all participants have a buddy with them whenever they were away from the experimental site was dropped. The mood of the men immediately brightened. In the meantime, the war had officially ended, and Keys hurried to write an interim report that would be of some help to relief workers. Unfortunately, the experiment was not yet completed, and Keys felt it would take months—if not years—to sift through all of the data that had been collected. Reluctantly, he published a provisional report in October 1945, describing the study, but it contained little of practical value. His scientific mind would not let him draw conclusions from incomplete data. He did not publish a complete report until several years later (Keys, Brožek, Henschel, Mickelsen, & Taylor, 1950).

Fortunately, one of the psychologists who had helped him devise the study, Harold Guetzkow, was less constrained. In January 1946, he published a decidedly nonscientific manual, filled with cartoons and practical suggestions, which would be of great value to relief workers (Guetzkow & Bowman, 1946). One thing that everyone agreed on—the human body was a remarkable thing. Its evolution had prepared it for all kinds of assaults, including the possibility of starvation. In the end, its evolutionary history produced a highly resilient organism.

## MASLOW’S THEORY OF NEEDS

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Abraham Maslow (1908–1970) was a little-known psychologist teaching at Brooklyn College in the 1940s. But while there, he wrote a paper that would form



the foundation for his later fame and would also, unintentionally, comment on—or perhaps explain—many of the phenomena observed in the Minnesota study (Maslow, 1943). His paper described a hierarchy of human needs that build on one another. He envisioned them as a pyramid. At the bottom of the pyramid are the most basic needs, physiological requirements such as oxygen and food. At the next higher level are safety needs, followed by the need for love and belonging, which are in turn followed by needs for esteem. At the very top of the hierarchy is the need for self-actualization, that is, a desire to live up to one's potential. For Maslow, self-actualization included a sense of being fully alive and finding meaning in life.

Maslow was flexible about the way in which needs dominated behavior, but one of his strong beliefs was their hierarchical nature. In his model, it was important for lower needs to be satisfied in order for higher needs to be explored and fulfilled completely. For instance, an individual lacking fulfillment in basic physiological needs, such as hunger, would have a more difficult time pursuing higher needs such as love or friendship. Needs at the very top of the hierarchy, including cultural interests and further education, would be at the greatest risk. Any deficiency in need fulfillment at the lower levels would jeopardize fulfillment at all of the higher levels.

Applying Maslow's model to the Minnesota Study provides a useful outline for the subject's behavior in the second phase. As their food supply was increasingly compromised, their inclination to pursue higher order needs was diminished. The items at the very top of the hierarchy, such as learning and creative expression, were the first to go unaddressed, followed by the next highest level—esteem needs. As the assault at the lowest level continued, other levels were compromised. While Maslow's model should not be followed too strictly—for instance, it does not address cultural variations—the hierarchy represents a compact set of guidelines to describe and summarize much of the aftermath of the starvation section of the experiment. It also provided insight into the treatment of disorders such as anorexia nervosa and bulimia. The implication from both the Minnesota study and Maslow's model is to treat the physical symptoms of starvation before attempting to treat the psychological issues involved.

## FOOD AND THE WAR

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Keys and his experimenters had accurately predicted the impact of the war on food supplies around the world. The United States had rationed certain foods such as sugar and coffee virtually from the beginning of the war, and citizens were encouraged to grow “victory gardens,” which many of them did. Psychologist Kurt Lewin



and others conducted studies on the best ways to encourage people to eat organ meats—such as kidney and liver—as a way to add options to the food supply, which were nutritious but not popular. However, few people were prepared for the images that would emerge from the German concentration camps. Survivors were walking skeletons. The war in Europe ended about halfway through the second phase of the experiment, so the study was not as helpful to wartime survivors as originally intended. Still, it is referenced today as one of the most important pieces of research on food and psychological issues.

## AFTER THE STUDY

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When the study ended, Ancel Keys did not drift into obscurity. In fact, he became even more famous with his research on the causes of heart disease. He became particularly well known for linking cholesterol and heart disease, a connection that has become commonplace in contemporary health care. Josef Brožek became a university professor and a noted historian of psychology. The subjects drifted back to a more normal life. Consistent with their levels of intelligence and education, they entered a variety of professions, with teaching and social work being among the most common. Six of them received doctorate degrees. Long after the study was completed, they continued to value their time in the study. They were unanimous in saying that they would do it all over again (Kalm & Semba, 2005).

The study continues to remind us of the relationship between food and a host of items, including mood, ambition, and body image. Dieters who have difficulty sticking to their regimen need to be reminded that it's not all about willpower. There is a built-in biological need to maintain body weight, a preservation mechanism. When that balance is challenged, the result is likely to be felt in other aspects of our lives, including the psychological.

## REVIEW/DISCUSSION QUESTIONS

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1. How were the subjects in the study selected? Is there a problem generalizing from the study because of its selective sample?
2. Would the results be different for women? Would age matter?
3. Are there ethical questions about the way the study was conducted? If so, what are the issues?

4. Describe Maslow's hierarchy of needs. Can you summarize the results of the study using Maslow's hierarchy as a guide?
5. What benefits were derived from the study? Does the study offer any suggestions for the modern treatment of eating disorders?

## NOTE

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The book by Todd Tucker cited in this chapter (see References) is a highly readable overview of the study, with many compelling case studies included. It is strongly recommended for anyone wishing to learn more about the study.