INSIDEOUT
Institute for Eating Disorders

The Effects of Starvation

The Minnesota Experiment was a landmark study conducted between November 1944 and December 1945 in the United States by Ancel Keys, a professor of physiology at the University of Minnesota and a consultant to the War Department. He wanted to study the effects of starvation and find the best way to provide post-war rehabilitation to people who had experienced severe deprivation and emaciation during the war.

This study observed the physical, psychological, and behavioural effects of starvation on healthy men by studying them under normal conditions, subjecting them to semi-starvation, and then following them through rehabilitation. The participants were young, physically, and psychologically healthy men who were World War II conscientious objectors.

(Keys et al, 1950)

The Minnesota Starvation Experiment

Out of 400 applications, 36 young (20–33-year-old) physically and psychologically healthy men were selected.

Throughout the study, researchers measured and tracked in detail physical and psychological information, such as body weight, size, strength, basic functions, behaviour, personality, and eating patterns.

Stages of the Experiment

Initial Standardisation Phase
(3 months)

Participants received 3200 kcal (13400 kJ) of food daily, which was the average amount the participants ate at home. The men reported feeling well-fed, having lots of energy and engaged in productive activities (e.g. admin tasks, University classes).

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Semi Starvation Phase
(6 months)

Participants received 1600 kcal (6600 kj) of food daily, approximately half of their previous intake. The effects of starvation became apparent. All participants experienced dramatic physical, psychological and social changes as a result of starvation.

Rehabilitation & Renourishment Phase
(3 months)

Participants were randomly assigned to 1 of 4 energy intake groups:
- 2000 kcal / 8400 kJ per day
- 2400 kcal / 10000 kJ per day
- 2800 kcal / 11700 kJ per day
- 3200 kcal / 13400 kJ per day

and were gradually re-fed to their healthy weight.

This phase proved the most difficult as the men struggled to return to normal eating. It took 2 months – 2 years for them to fully recover.

What are the Effects of Starvation?

The men reported experiencing a wide range of changes; physically, psychologically, socially and behaviourally as a result of being in semi-starvation. Below are some of the symptoms that can be experienced as a result of being in a state semi-starvation.

Physical changes:

- Weight loss of 38 lb (17 kg) - their average weight at the beginning of the study was 153 lb (69 kg), and their average weight after starvation was 115 lb (52 kg), therefore an average weight loss of 25% body weight
- Decreased need for sleep
- Dizziness and headaches
- Hypersensitivity to noise and light
- Reduced strength was even apparent in the first few days
- Oedema despite skeletal appearance
- Complaints of feeling constantly tired
- Lack of body fat meant that it became difficult to sit down because of pain, and they felt cold all of the time
- Metabolism slowed down to conserve energy - Heart rate slowed from 55 bpm to 35 bpm, blood volume dropped 10%, and heart size shrank
- Impaired thermoregulation – they were always cold, particularly in hands and feet
- Parasthesia (tingling) in hands and feet
- GI discomfort with bowels opening on average once a week
- Hair loss

Changes in attitudes and behaviours:

- Despite weight loss, the men did not perceive themselves as excessively skinny, they actually thought everyone else looked too fat
- Increased preoccupation with food - concentration was difficult because of constant thoughts of food
- Food became main topic of conversation, reading and daydreams. Many started reading cookbooks, collecting recipes and kitchen utensils
- Increase in food hoarding
- Despite little interest in cooking pre-experiment, 40% expressed cooking as part of post-experiment plans
- They spent a large portion of their day planning their allotted food
- They delayed their eating and savoured their food – towards the end of the experiment they were taking 2 hours to eat
- They ate in silence and devoted total attention to eating
- There was a huge increase in salt and spices
- They were eating up to 40 packs gum and drinking 15 coffees per day
- Several men failed to follow their diets and reported episodes of bingeing followed by purging because they felt physically sick and emotionally affected
- Some men exercised deliberately at times. Some of them attempted to lose weight by driving themselves through periods of excessive exercise in order either to obtain increased bread ration or to avoid reduction in rations

Emotional changes:

- Some reported short term, and others, longer term periods of depression, with an overall lowering of the threshold for depression
- Occasionally elation was observed, but this was certainly followed by “low periods”
- Although the men had quite easy-going natures prior to starvation, this was replaced by irritability and frequent outbursts of anger
- For most subjects, anxiety became more evident
- Many of the formerly even-tempered men began biting their nails or smoking because they felt nervous

- Apathy became common, and some men who had been quite meticulous, neglected various aspects of their personal hygiene
- Most experienced low libido

Social changes

- Although originally quite social, the men became progressively more withdrawn and isolated
- Humour and comradeship decreased steadily within growing feelings of social inadequacy
- Social initiative and sociability decreased with the men becoming reluctant to plan activities, to make decisions, and to participate in group activities. They spent more and more time alone
- Social contact with women also declined sharply and those who continued to see women socially found that their relationships became strained

Cognitive changes:

- Impaired concentration
- Decreased alertness
- Difficulties with comprehension
- Impaired judgement

Renourishment Phase

- In the renourishment phase the participants were assigned to 2000 kcal (8400 kJ), 2400 kcal (10000 kJ), 2800 kcal (11800 kJ), or 3200 kcal (13400 kJ) per day
- It was found that those in lower energy intake groups were not recovering and so the energy prescription was increased by an additional 800 kcal (3300 kJ) per day in all groups
- It was found that 4000 kcal (16700 kJ) per day was needed to rebuild their strength
- During the 12-week rehabilitation stage, most of the changes in attitudes and behaviours continued
- After about 5 months of rehabilitation, the majority of the men reported some normalisation of their eating patterns
- The emotional difficulties did not immediately reverse themselves during rehabilitation. It was therefore assumed the abnormalities were related more to body weight than to short-term calorie intake
- During rehabilitation, sexual interest was slow to return. Even after 3 months the men judged themselves to be far from normal in this area. However, after 8 months of renourishment, virtually all of the men had recovered their interest in sex
- During rehabilitation metabolism again sped up to normal levels
- Those subjects who gained the most weight became concerned about their increased sluggishness, general flabbiness, and the tendency of fat to accumulate in the abdomen and buttocks
- On average they gained back their original weight plus about 10%. Then, over the next 6 months, their weight gradually declined. By the end of the follow-up period, they were approaching their pre-experiment weight

(Kalm & Sember, 2005)

Relevance to Working with Individuals with Disordered Eating Patterns

The Minnesota Experiment illustrates how a person becomes more orientated towards food when starved and how other pursuits important to his/her survival become secondary to the primary drive toward food.

This has often been termed as 'The Starvation Syndrome'. The Starvation Syndrome, or features of it, can be triggered by any significant energy deficit brought about by restriction, purging or excessive exercise. This means that even if a person appears to have an adequate energy intake, or appears to be within or above a healthy weight range, they can still experience the symptoms of starvation. (CCI, 2018)

Seeing as many of the symptoms experienced by the participants in the study were caused by undernutrition and being underweight or having lost weight, it is absolutely essential that weight be returned to “normal” levels in order for the person to recover. Psychoeducation about the effects of starvation is an important part of engagement and treatment. These symptoms, which affect the person’s quality of life, can often be used as a motivating factor to support increasing calorie intake or reducing purging behaviours.

This is why it is so important to have treatment that focuses on both the physical (renourishment and weight restoration) and psychological (therapy). Renourishment can help correct the effects of starvation, while the psychological therapy and nutrition therapy works with the client in recovery from their eating disorder. For the client with an eating disorder, both are essential.

Kalm, L., & Semba, R., (2005). They Starved so that Others be Better Fed: Remembering Ancel Keys the Minnesota Experiment. *Journal of Nutrition*, 135 1347-1352

Keys, A., Brozek, J., Henschel, A., Mickelsen, O., & Taylor, H. L. (1950). The Biology of Human Starvation (2 Vols.). University of Minnesota: Minneapolis Press

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