

Effects of Semi-starvation on Behaviour and Physical Health The Minnesota Experiment

There is remarkable similarity between the experiences of people who have experienced long periods of semi-starvation and those of people with anorexia or bulimia nervosa. In the 1940s to 1950s, Ancel Keys and his team at the University of Minnesota in the USA studied the effects of starvation on behaviour. What they found both surprised and alarmed them.

The experiment involved studying 36 young, healthy, psychologically normal men, (1) during a period of normal eating, (2) during a longer period of fairly severe food restriction, and (3) after the food restriction was lifted. During the first three months of the experiment, the subjects ate normally whilst their behaviour, personality and eating patterns were studied. Over the next six months, the men were given approximately half the amount of food that they needed to maintain their weight and they lost, on average, 25% of their original body weight. Some participants actually went down to a BMI of 14. Following this, there were three months of rehabilitation during which time the men were re-fed. In general, the men experienced dramatic physical, psychological and social changes as a result of food restriction. Of note was the fact that for many, these changes persisted even after weight returned to normal.

Attitudes and behaviour related to food and eating.

One of the most striking results of the experiment was that they found it increasingly difficult to concentrate on more 'normal' things, and became preoccupied with thoughts of food and eating. Food became a principal topic of conversation, of reading and of daydreams. Many men began reading cookbooks and collecting recipes, whilst others became interested in collecting various kitchen utensils. One man even began rummaging through rubbish bins in the hope of finding something that he might need. A desire to hoard has been seen in both people and animals that are deprived of food. Although food had been of little interest to the men prior to entering the experiment, almost 40% of them mentioned cooking as part of their post experiment plans. Some actually did change their career to a career focused on food once the experiment was over.

The men's eating habits underwent remarkable changes during the study. Much of the day was now spent planning how they would eat their allocated food. Additionally, in order to prolong their enjoyment of the food eaten, it would take them a much longer amount of time to eat a meal. They would eat in silence and would devote their total attention to the consumption of the food.

The subjects of the study were often caught between conflicting desires to gulp down their food ravenously and to consume it so slowly that the taste and smell of each morsel of food would be fully appreciated. By the end of the starvation period of the study, the men would take almost two hours to finish a meal that they previously would have consumed in a matter of minutes.

Another common behaviour was that they would make unusual concoctions by mixing different foods together. Their use of salt and spices increased dramatically, and the consumption of tea and coffee increased so much that they had to be limited to 9 cups per day. The use of chewing gum also became excessive and also had to be limited.

During the 12 weeks re-feeding phase of the experiment, most of these abnormal attitudes and behaviours to food persisted. Some of the men had more severe difficulties during the first six weeks of re-feeding. The free choice of ingredients stimulated 'creative' and 'experimental' playing with food; for example, licking of plates and very poor table manners persisted.

Binge eating

During the restrictive phase of the experiment, all of the volunteers reported feeling more hungry. Whilst some appeared able to tolerate this fairly well, for others it created intense concern or even became intolerable. Several of the men failed to stick to their diet and reported episodes of binge eating followed by self-reproach. While working in a grocery store, one man:

Suffered a complete loss of willpower and ate several cookies, a sack of popcorn, and two overripe bananas before he could "regain control" of himself. He immediately suffered a severe emotional upset, with nausea, and upon returning to the laboratory he vomited. He was self deprecatory, expressing disgust and self criticism.

After about five months of re-feeding, the majority of the men reported some normalisation of their eating pattern, but for some the difficulties in managing their food persisted. After eight months, most men had returned to normal eating patterns, although a few still had abnormal eating patterns. One man still reported consuming around 25% more than he did prior to the weight loss.

Emotional changes

It is important to remember that the men were psychologically very healthy prior to the experiment but most experienced significant emotional changes as a result of semi-starvation. Many experienced periods of depression; some were brief whilst others experienced protracted periods of depression. Occasionally elation was observed, but this was inevitably followed by "low periods". The men's high tolerance level prior to starvation was replaced by irritability and frequent outbursts of anger. For most men, anxiety became more evident; many of the formerly even-tempered men began biting their nails or smoking if they felt nervous. Apathy was a common problem, and some men neglected their personal hygiene.

Both observation and personality testing showed that the individual emotional response to semi-starvation varied considerably. Some of the volunteers seemed to cope very well whilst others displayed extraordinary disturbance following weight loss. As the emotional difficulties did not immediately reverse once food was in ready supply, it would appear that the abnormalities were related more to body weight than to short-term calorie intake. So, we can draw the conclusion that many of the psychological disturbances seen in anorexia and bulimia nervosa are likely to be the result of starvation.

Social and sexual changes

Most of the volunteers experienced a significant change in their social behaviour. Although originally quite gregarious, the men became progressively more withdrawn and isolated. Humour and a sense of friendship and comradeship diminished markedly amidst growing feelings of social inadequacy.

Social initiative and sociability in general, changed dramatically. The men became reluctant to plan activities, to make decisions and to participate in group activities ... they spent more and more time alone. It became "too much trouble" or "too tiring" to have contact with people.

The volunteers' social contacts with women also declined sharply during semi-starvation. Those who continued to see women socially found that the relationships became strained.

One man described his difficulties as follows.

“I am one of about 3 or 4 who still go out with girls. I fell in love with a girl during the control period but I see her only occasionally now. It is almost too much trouble to see her even when she visits me in the lab. It requires effort to hold her hand.

If we go to watch a show the most interesting part of it for me is the scenes where people are eating”.

During the rehabilitation period the men’s sexual interest was slow to return. Even after three months they judged themselves to be far from normal in this area. However, after eight months some or virtually all of the men had recovered their interest in sex.

Cognitive changes

The volunteers reported impaired concentration, alertness, comprehension and judgement during semi-starvation. This improved after re-feeding.

Physical changes

As the six months of semi-starvation progressed, the volunteers exhibited many physical changes including: gastrointestinal discomfort, decreased need for sleep, dizziness, headaches, hypersensitivity to noise and light, reduced strength, oedema (fluid retention), hair loss, decreased tolerance of cold temperatures (cold hands and feet) and parasthesia (abnormal tingling or prickling sensations, especially in the hands and feet). There was an overall decrease in metabolism (decreased body temperature, heart rate and respiration).

During rehabilitation, the metabolism speeded up again, especially in those who had the larger increases in food intake. Volunteers who gained the most weight described being concerned about their increased sluggishness, general flabbiness and the tendency for the fat to accumulate around the stomach and buttocks.

These complaints are very similar to those described by people with bulimia and anorexia describe as they gain weight. However, after approximately a year the men’s body fat and muscle levels were back to their pre-experiment levels.

Physical activity

In general, the men responded to semi-starvation by reducing their activity levels. They became tired, weak, listless, apathetic and complained of a lack of energy. Voluntary movements became noticeably slower. However, according to the original report, *Some men exercised deliberately at times. Some of them attempted to lose weight by driving themselves through periods of excessive energy in order to either obtain increased bread rations ... or to avoid reduction in rations.*

This is similar to the practice of many patients, who feel that if they exercise strenuously they can allow themselves a bit more to eat.

Significance of the study

As all of the volunteers were psychologically and physically healthy prior to the experiment, all of the symptoms experienced by them can be put down to the period of starvation. It would appear therefore that many of the symptoms faced in anorexia nervosa and bulimia nervosa are a result of food restrictions rather than the illnesses themselves. And it is important to recognise that these symptoms are not just limited to food and weight, but extend to virtually all areas of psychological and social functioning.

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It is also important to recognise that the men's relationship with food was not normal even after they returned to eating. In the short term they felt out of control with regards to their food intake and were unable to identify when they felt hungry or when they felt full. Many of these symptoms continued after they reached a normal weight and, for some it took several months and years for this to normalize.

It is therefore important for someone recovering from anorexia nervosa or bulimia nervosa to understand that they cannot just expect their body to return to being able to regulate food intake on its own. We know that consuming a well-balanced and nutritionally complete diet, spread out over regular points during the day, encourages the body's ability to once again recognise when it is hungry and when it is full.

Source: Garner, D.M and Paul E Garfinkel P.E (eds) (1997) Handbook of Treatment for Eating Disorders, 2nd ed.



Effects of semi-starvation: a summary

Attitudes and behaviour related to eating

- increased preoccupation with food and meal times
- using more seasoning and spices in food
- increased consumption of tea, coffee & chewing gum
- tendency to hoard
- change in speed of eating
- increased hunger

Emotional changes

- depression
- anxiety
- irritability
- apathy

Social and sexual changes

- withdrawal
- reduced sense of humour
- feelings of social inadequacy
- isolation
- strained relationships
- reduced sexual interest
- neglected personal hygiene

Cognitive changes

- impaired: concentration, alertness, comprehension, judgement

Physical changes

- gastro intestinal discomfort
- reduced need for sleep
- dizziness
- headaches
- hypersensitivity to noise and light
- reduced strength
- oedema (fluid retention)
- hair loss
- reduced tolerance for cold temperatures
- abnormal tingling/pricking sensations in hands & feet

Activity and Motivation

- tiredness
- weakness
- listlessness
- reduced activity levels