

Body Weight “Set Point”



What We Know and What We Don't Know

by Stephen C. Woods, PhD

The amount of fat in the body, also known as total body adiposity, is a major component of body weight. Although it may go up and down from time to time, the amount of body fat (and hence body weight) most people carry is relatively stable and appears to be controlled or maintained at a level that is sometimes called a “set point.”

Evidence of Set Point in Action

The best evidence for this is that when people go on a diet and voluntarily eat less food, most are able to lose at least some weight. However, throughout time, as attention to maintaining the lost weight decreases, body weight creeps back up, generally to about the same level as occurred before the dieting began. This discouraging outcome may occur several times for some individuals throughout their lifetime as they keep attempting to lose weight; i.e., they try one or another diet that is popular at the time, lose some weight, and then regain it throughout a period of weeks or months.

If body fat tissue is removed by means other than dieting, for example when someone undergoes lipectomy or liposuction to reduce body fat, the typical result is that while body weight is initially lowered, the person increases the amount of food eaten, allowing body fat to return to its former, pre-operation level.

The factors influencing body weight are symmetrical, working in both directions. That is, when weight-stable individuals are paid to eat more food and gain weight, they are able to do it; but throughout time, the process becomes harder and harder and they typically fail at some point and fall back to the lower weight they were carrying before the

period of overeating occurred, and they accomplish this by eating less food than normal.

All of these findings imply that the brain areas that control food intake and energy usage are able to monitor how much fat is present in the body, and to respond to changes in body fat by making offsetting changes in food intake. In this regard, the control of body weight and food intake is somewhat like the system that keeps your house at the appropriate temperature. You determine the set point for the room temperature you want to experience by adjusting the thermostat. When room temperature decreases below that set point, the furnace turns on and room temperature is increased. If the room temperature rises above the set point, the furnace shuts off; and in some home-temperature systems an air conditioner might come on. Unless there is a major problem (such as a furnace breakdown or a door left open), this kind of regulatory system maintains the temperature inside your house at near the set point most of the time.

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Body Weight Regulation

Body weight regulation (or control) appears to be similar to set point, relying upon an internal body fat thermostat that is sensitive to total body fat and has the ability to influence a range of responses to increase (eating more food, reducing metabolic rate) or decrease total body fat (eating less food, increasing metabolic rate). While the nature of the body fat thermostat is not completely understood, it relies in part upon hormones (such as leptin and insulin) that are released into the blood in proportion to body fat and that enter the brain in areas including the hypothalamus where they influence specific brain centers controlling food intake.

If a person's weight starts creeping up, the body secretes more leptin and insulin, and these in turn act on the brain to reduce food intake; similarly, when weight is reduced by dieting or other means, the reduced hormone levels signal the brain to increase appetite. Because of these processes, it is difficult for most people to maintain a weight that is different from their set point for long periods of time.

Specifics of the Set Point

The set point for body weight varies among people, with some remaining lean throughout their lives while others remain at a normal weight or in the obesity range. There is also evidence for a genetically determined weight trajectory in some people, for example that keeps weight low until middle age and then allows it to increase. The genes one inherits from his or her parents are one major influence on the value of the set point, and nutritional factors before and soon after birth are also thought to be important. Rather than being permanently fixed, the weight set point

is influenced by several environmental factors and can change. For example, the average palatability or desirability of one's food is important, with chronic consumption of more palatable food generally resulting in a higher weight set point. Because of this, people tend to change weight when the food environment changes, for example when students go off to college. Stress is also an important factor, with most people maintaining lower body weights when faced with chronic stress. In contrast, some individuals tend to eat more food and gain weight in certain stressful situations, and this is often known as the comfort food phenomenon in which certain foods provide relief from stress. Excessive exercise can also lower the average amount of body fat carried.

An important question is whether an individual is stuck with whatever set point they happen to have; i.e., Are individuals affected by obesity doomed to remain affected by it in spite of their best efforts at dieting and healthy living? The answers are important for several reasons:

- The concern over excess body fat, of course, is that more body fat is associated with poorer health and increased risk for cardiovascular disorders, diabetes mellitus, some cancers and many other health problems.
- Obesity is also associated with numerous negative psychological and social factors.
- The United States and many other countries are experiencing an obesity epidemic, making it more critical to find ways to lose weight and keep it off.

Brain Activity and Weight

It has been recognized for decades that brain activity is a major factor affecting the body fat set point. When certain parts of the brain's hypothalamus are destroyed in experimental animals, this can lead to a permanent change in the level of body fat that is maintained throughout time. Brain injuries in some parts of the hypothalamus result in elevated set points, while injuries in other areas result in greatly reduced set points. Likewise, tumors or strokes in those same areas of the brain in humans can also permanently change the set point.

Causing brain injuries in order to treat obesity is not a viable option, for in addition to the safety and ethical issues, any such injury also impacts brain circuits controlling other behaviors, such as mood. However, simply recognizing that there are brain circuits that can be manipulated and that have selective effects on the body fat thermostat is a major step forward.

The important point is that activity in certain specific areas of the brain is capable of changing the body weight set point, and while creating injuries in the brain is not a realistic treatment option, there may be other ways to tap into the system and reset the thermostat. Historically, the two options open to individuals affected by obesity in their attempts to lose weight have been lifestyle changes (chronic dieting and exercise) or medication. While both

can be effective in producing some weight-loss, most people find it difficult to follow these treatments for the long term. More recently, a third option has become available, bariatric surgery.



Bariatric Surgery - Can it change your set point?

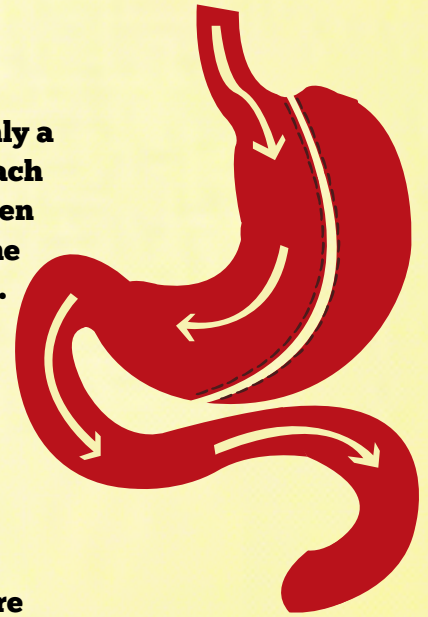
Although several different such procedures that have been developed in recent years result in successful weight-loss, they all share the property of interfering with the passage through the gastrointestinal tract of food that has been eaten. By far, the two procedures that are most effective in this regard are roux-en-y gastric bypass (RYGB) and vertical sleeve gastrectomy (VSG). Both result in reduced food intake and long-term meaningful weight-loss as well as improved metabolic and health parameters; and both result in longer lives and an improved quality of life.

RYGB and VSG

In RYGB, the gastrointestinal tract is altered such that as swallowed food exits the esophagus, rather than passing into the stomach and then on to the intestines as would normally occur, it bypasses the stomach altogether and directly enters a midpoint of the intestine.



In VSG, most of the stomach is surgically removed such that only a thin cylinder of stomach tissue remains between the esophagus and the start of the intestines. Thus in RYGB there is no contact of food with the stomach or the first half of the intestine, whereas in VSG the food passes through a smaller stomach and the entire length of the intestine.



While it was initially thought that the weight-loss was due either to a restricted stomach size and/or poor absorption of food, neither is now known to be the case.

What is particularly striking is that in spite of quite different ways of rerouting swallowed food, the two procedures result in comparable improvements in body weight, diabetes and other metabolic symptoms. Body fat in particular settles at a new, considerably lower weight and acts as if there has been a lowering of the body fat thermostat. The question many laboratories are trying to answer is how does it work? Do RYGB or VSG somehow fool the weight-regulatory process in the brain?

While this is currently a hot area of research and exact mechanisms are not yet known, the best evidence is that the body fat set point is indeed lowered. In both humans and animal models, the events that occur after RYGB or VSG are similar. Appetite is initially reduced and body weight/fat declines throughout time. However, body weight does

not keep going down indefinitely. Rather, as less food is eaten, body weight keeps declining until it settles at a new, much lower and much healthier level, and once that lower plateau is attained, food intake returns to near normal. Interestingly, symptoms of diabetes mellitus also start improving soon after the surgery, with many individuals seeing normal blood sugar levels long before significant weight is lost.

Recent research with animals has shown that some process common to VSG and RYGB likely results in changed information reaching the brain's body fat thermostat, and individuals respond to this new information by eating less and attaining a new and healthier weight. While it is not known exactly how signals related to body fat content that reach the brain are altered after bariatric surgery, considerable research is currently aimed at this question. Nonetheless, the process takes advantage of the natural weight control system that already exists.

Conclusion

The overall take-away point is that, unlike what happens with dieting or taking weight-loss medications in an effort to lose weight, some types of bariatric surgery seem to change the body fat set point such that it is permanently set at a lower level. What is especially exciting is that people undergoing bariatric surgery have been found to maintain their new, lower body weight for 20 years or more and to live longer on the average than individuals not receiving surgery, presumably due to reduced health risks.

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ABOUT THE OBESITY ACTION COALITION (OAC)

The Obesity Action Coalition (OAC) is a National non-profit organization dedicated to giving a voice to individuals affected by obesity and helping them along their journey toward better health. Our core focuses are to elevate the conversation of weight and its impact on health, improve access to obesity care, provide science-based education on obesity and its treatments, and fight to eliminate weight bias and discrimination.



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The OAC knows that the journey with weight can be challenging but we also know that great things happen when we learn, connect and engage. That is why the OAC Community exists. Our Community is designed to provide quality education, ongoing support programs, an opportunity to connect, and a place to take action on important issues.

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