You are what you don’t eat: Genetics of anorexia and bulimia

An adolescent girl either refuses to eat, obsesses with aerobic exercise or binges secretly and then intentionally, getting rid of the food either by vomiting or by abusing laxatives.

That’s the typical image that the general public has of the two eating disorders discussed most often in mainstream media: anorexia nervosa (AN) and bulimia nervosa (BN). While the public does have the basic idea, many people may not appreciate the extent to which these conditions affect one’s overall medical health, that these are recognized psychiatric disorders that are potentially deadly, and that they’re at center stage of genetics research.

Not only have advances in neurobehavioral science and genetics led to major insights as to the causes of eating disorders, but the latest research shows how AN in particular produces a cascade of physical and mental effects, including direct alternation of the person’s genes. Importantly, the amount of genetic alteration depends on how much time the individual has been suffering from AN. This makes it all the more important for health professionals, in the clinic, in schools and perhaps even in work places, to recognize people at risk, so the condition can be diagnosed and managed early.

Anorexia and bulimia: Understanding the difference

The criteria for diagnosis of AN, BN, and other eating disorders have been modified slightly as the Diagnostic and Statistical Manual (DSM- the authoritative book that mental health professionals use in diagnosis mental illness) has evolved over the years. However, the current DSM, called DSM-V, preserves a basic idea from older DSM versions, that body weight is the criterion that distinguishes between AN and BN. In both conditions, the individual has a false perception of his or her body form with an extreme obsession aimed at avoiding a weight gain, and individuals carry an elevated risk of suicide. Tactics employed to prevent weight gain in either condition may include avoiding food and over-exercising or intentionally inducing vomiting or using laxatives after binging, but if the individual is significantly below the normal body weight for his or her height, the diagnosis is AN; otherwise it is BN.

Quite often, those using the vomiting tactic are only slightly below, slightly above, or equal to normal body weight, because some food does get digested after a binge. Therefore, the public typically associates binging-vomiting with BN and food avoidance with AN, but technically it’s the weight that determines the diagnosis. Also, while both conditions typically afflict females, usually white teens, it’s important to keep in mind that approximately 10-15 percent of cases occur in males, and both conditions can affect all age groups and ethnicities.

Because starvation produces physical effects different from the effects of vomiting and laxative abuse, the medical consequences of AN and BN are very different. For instance, AN is associated with delayed growth, delayed puberty, and other complications caused by deficiencies in various nutrients. In contrast, since BM typically correlates with induced vomiting, patients often are afflicted with damage due to stomach acid passing through the esophagus, throat, and mouth. Also, the loss of stomach acid changes body pH, which can have a major impact on the heart beat, putting the individual at risk of fatal

arrhythmias, plus various other organ systems are affected, along with cognition, judgement, and other mental functions.

Nature and nurture

As with most other psychiatric conditions, the genetics of eating disorders comes into play as part of what's called the bio-psycho-social model of illness. Effects of genes on the brain, a person's thoughts, and interactions with other people all interact in the mind in complex ways, and the illness results from that interplay. An individual thus can be genetically prone to a particular psychiatric condition, or category of conditions -they may carry a gene associated with a mood disorder, anxiety disorder, or a psychotic disorder- but this does not mean that the disease will ever manifest. Put the person under stressful social or psychological conditions, however, and they may start showing symptoms.

Looking at eating disorders, having a monozygotic (genetically identical) twin with AN or BN increases one's likelihood of developing the same condition much more than having an heterozygotic (fraternal) twin (or other first-degree relative) increases the likelihood. The reason for this apparent hereditary association may involve genetic influences on three neurotransmitters: serotonin, norepinephrine, and dopamine. In the brains of AN and BN patients, serotonin and norepinephrine levels are abnormally low, while dopamine is either too high or not regulated correctly in certain areas of the brain.

These same three neurotransmitters are also known to be disrupted in depression and hypoactive sexual desire disorder (HSDD). Drugs used to treat depression by resetting serotonin and norepinephrine levels also help with obsessive compulsive disorder (OCD), and OCD and depression often occur in eating disorder patients. Additionally, certain disrupted levels of hormones, particularly cortisol, vasopressin, and cholecystokinin (CCK), may play an important role, and thus genetics effecting these hormones may be a factor.

In addition to genetics being among the causes of eating disorders, the genetic connection also works in the other direction. According to a new Canadian study conducted in Montreal, AN, especially when it's long-term, actually changes how one's genes are expressed. The phenomenon is known as epigenetics, and it works based on a chemical change called methylation. The level of methylation on a gene determines whether the gene is turned on or off, so by affecting how much various genes are methylated, one's nutritional state can really mess with cell function throughout all body systems, including the brain.

This can make for a vicious cycle. In the words of Howard Steiger, one of the researchers on the Montreal study: "We already know that eating disorders, once established, have a tendency to become more and more entrenched over time. These findings point to physical mechanisms acting upon physiological and nervous system functions throughout the body that may underlie many of the effects of chronicity."

In other words, AN by its nature reinforces itself, and the study suggests why, so the question now is what to do with the knew knowledge.

"All in all, [the results of the study] point to the importance of enabling people to get effective treatments as early in the disorder process as possible," Steiger notes, but a more intriguing prospect is the idea of

restoring the DNA back to normal.

If the methylation resulting from the AN can be reversed, researchers believe that the condition could improve. This would be a huge achievement, not only in connection with eating disorders, but overall in medicine, since there are a variety of other conditions that are now thought to have an epigenetic cause. A prime example is smoking. In addition to damaging the smoker directly, and bystanders with second- and third-hand smoke, smoking also causes epigenetic changes, which are passed down to future generations. If you have a parent or grandparent who smoked before you were conceived, you could be affected no matter how good your own health behaviors, but the prospect of restoring epigenetically modified DNA changes everything.

David Warmflash is an astrobiologist, physician, and science writer. Follow @CosmicEvolution to read what he is saying on Twitter.