

*Module 2, Lesson 2 Handout:*  
**Obesity & Genetics Research**

While you most likely won't have clients handing you genetic testing results and asking you to identify if they have a genetic mutation, it's pretty neat to learn how genes play a role in obesity. Genetic testing is a new area of research that has gained many people's interest. An understanding of obesity and genetics research and the common terms and genes associated with obesity is important in counseling your clients to the best of your ability. It's also important to recognize that the science in this area is developing, so genetic testing and interpretation may become more widespread with clients in the future.

One of the most notable studies in the world of obesity and genetics was published in 1990 in the *New England Journal of Medicine*. Researchers studied 673 pairs of identical and fraternal twins who were either raised together or apart. They concluded that genetic influences on body mass index are substantial versus the environment which had little to no influence. These findings were in line with previous twin and adoptee studies. Before the genomic era, studies of family members, twins and adoptees offered indirect scientific evidence that a sizable portion of the variation in weight among adults is due to genetic factors.

### **Genetic Etiology of Obesity**

Modern technology has helped make incredible advances in deepening our understanding of what was discovered in previous studies and uncovering new molecular and genetic mechanisms related to obesity. The genetic causes of obesity can be categorized into the forms listed below.

**Monogenic Obesity:** The gene causing obesity is clearly identified and caused by a single gene mutation. This type of obesity is rare, and typically associated with a gene mutation in the leptin-melanocortin pathway. This pathway plays an important role in controlling hunger and satiety. A mutation of the genes that encode leptin and the leptin receptor lead to decreased satiety and increased food intake, and is often linked to early-onset obesity.

**Polygenic/Common Obesity:** There are several gene variations that cause obesity, and this is heightened in an environment that promotes weight gain. This type of obesity is common, hence the name, and it's estimated that there are over 100 gene variants that may each contribute a small amount to obesity.

**Syndromic Obesity:** There are over 25 forms of syndromic obesity including Prader Willi syndrome, Bardet-Biedl syndrome, Alstrom syndrome and Wager syndrome to name a few. Syndromic obesity is associated with cognitive deficits and has a specific effect on food intake. The relevance of the genes identified in syndromic obesity for general obesity is not clear. Many forms of syndromic obesity are categorized as an autosomal recessive disorder, meaning the person has

inherited two mutated genes making them more at risk for developing a condition than if they were to inherit one mutated and one normal gene.

### Genes Associated with Obesity

In most obese people, no single genetic cause can be identified. Since 2006, genome-wide association studies have found more than 50 genes associated with obesity, most with very small effects. Several of these genes also have variants that are associated with monogenic obesity, a phenomenon that has been observed in many other common conditions. Most obesity seems to be multifactorial, that is, the result of complex interactions among many genes and environmental factors. We know that we consume food partly in response to the brain regulating what we eat. Fat tissue, the pancreas and the digestive tract all “talk” to the brain via hormones (leptin, insulin, ghrelin) and then the brain tells us to eat more, stop eating etc. Genes are what makes these hormones react the way they react.

Below is a table outlining specific genes with variants that are associated with obesity and their role in the body.

Gene Symbol	Gene Name	Gene Product’s Role in Energy Balance
<i>ADIPOQ</i>	Adipocyte-, C1q-, and collagen domain-containing	Produced by fat cells, adiponectin promotes energy expenditure
<i>FTO</i>	Fat mass- and obesity-associated gene	Promotes food intake
<i>LEP</i>	Leptin	Produced by fats cells
<i>LEPR</i>	Leptin receptor	When bound by leptin, inhibits appetite
<i>INSIG2</i>	Insulin-induced gene 2	Regulation of cholesterol and fatty acid synthesis
<i>MC4R</i>	Melanocortin 4 receptor	When bound by alpha-melanocyte stimulating hormone, stimulates appetite
<i>PCSK1</i>	Proprotein convertase subtilisin/kexin type 1	Regulates insulin biosynthesis
<i>PPARG</i>	Peroxisome proliferator-activated receptor gamma	Stimulates lipid uptake and development of fat tissue

Table from Centers for Disease Control and Prevention

<https://www.cdc.gov/genomics/resources/diseases/obesity/obesedit.htm>

## Your Role

You don't need to be a genetic expert to address the role that genes play in a person's health and weight. Individuals with a family history of obesity may be more likely to gain weight than those with no family history. This is why we ask about family history in the client intake. We don't know exactly why biological relatives are more similar in body weight. We don't know which genes and how those genes affect energy metabolism. When the environment is controlled, we know people with different genes respond differently. For example, when food is scarce, some store fat and others lose. The different responses are largely due to genetic variation between individuals.

We know that behaviors, genes and environment all play a role in obesity. We also know that weight, BMI and other measures of obesity are not as important as the lifestyle choices you discuss with your clients. As fascinating as the research in obesity and genetics is, it's still new and we can't control genetics. Rather than trying to educate your clients on the genes that either do or don't predispose them to obesity, continue to focus on modifying behaviors and building healthy habits that will help them live a Nutritious Life. If a client does have a family history of obesity, empathize with your client that some elements of their weight may be out of their control, and use this information to set realistic goals with your client, focusing on those lifestyle factors and tracking measurements such as blood pressure or cholesterol, for example, rather than weight.