A LINE ON LIFE

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Two Sides of Deadly Genes *

David A. Gershaw, Ph.D.

Although genes are the basis of our abilities, they often hold the key to our destruction. When we have to watch young children die because of genetic defects, it is especially hard. Families who go through this trauma wonder why it happens. There may be a natural explanation — genes that kill also serve some positive purpose. How does this work?

Genes typically occur in pairs — one gene from your father and one gene from your mother. Some genes are **dominant**, needing only one gene to cause a particular trait. Other genes are **recessive** — both genes must combine to cause a particular trait. If you only have one gene in a pair with a recessive trait, you are called a **carrier**. The fabled disease carrier, "*Typhoid Mary*," passed typhus to others, even though she did not display any symptoms. Similarly, if you are a genetic carrier, the trait will not be evident in you, but you can pass it on to others — your children.

Many deadly genes previously had an adaptive function.

Sickle-cell anemia is a recessive disease that causes red oxygen-carrying blood cells to change from their normal round shape to a disordered crescent shape. If you only have one gene, you will be healthy, but you will still be a carrier for this disorder. However, children who inherit both genes die from a lack of healthy red blood cells. This sickle-cell gene is found in descendents of black Africans and others from the Mediterranean area, the Arabian Peninsula and India. In the United States, about 10% of blacks carry this gene. But in Africa, the proportion rises to about 40%. Why?

In areas where **malaria** is common, carriers of sickle-cell anemia have a survival advantage. They are less likely to die of malaria, because their red blood cells do not provide a good medium for the growth of malaria parasites. However, it is a grim trade. If two carriers mate, they have a 25% chance of having a child who will inherit the sickle-cell genes from both of them. The child will die an early death from anemia. A few children will die, but the more numerous carriers can survive malaria. However, with no malaria in the United States, all we see here is the deadly side of the bargain.

This also seems to exist with **Tay-Sachs disease** — a fatal childhood neurological disorder typical of Jews from Eastern Europe. This recessive gene might have protected carriers from tuberculosis, when that disease was a leading killer. With the ghettos of Europe teeming with tuberculosis, those with single genes were more likely to survive. However, once tuberculosis was conquered, all we see is the tragic results with those who inherit both genes.

Cystic Fibrosis is another childhood killer. It is the most common recessive disorder of whites of European descent. However, the gene might have protected carriers from deadly diarrhea caused by bacterial infections. Although "*Montezuma's revenge*" might seem funny, it was once a much greater risk for childhood death than cystic fibrosis.

Another likely example is **hemochromatosis** — a disease that causes increased absorption of iron. Eventually, the body stores so much iron that the person dies of iron poisoning. However, in this case, the effect differs between men and women, with the men showing the negative effects. Typically men lose very

little iron, so they are unlikely to get rid of the excesses. However, most women lost iron through menstrual bleeding, pregnancy and nursing. So this disorder could actually be good for women — insuring their survival.

Another possibility — **diabetes** — suggests that the same people can be both the beneficiary and the victim of the same gene. Until the use of insulin injections, diabetes was deadly. If it was so deadly, why aren't there fewer people with diabetes?

Diabetes has a more complex hereditary mechanism than just being dominant or recessive. There is evidence that diabetes-related genes also protect the fetus from miscarriages. If one parent is a carrier, then by chance, half of the children should inherit the diabetic gene. However, studies found up to 72% of the children had the diabetes-related gene. This led some researchers to conclude that the babies with the normal gene are more likely to miscarry than the ones with the diabetes-related gene. Though people with the diabetes-related gene were more likely to die of diabetes, they were more likely to be born in the first place.

Some genes cause miscarriages. The frequency of miscarriages is about 15%, but this is when the pregnancy has lasted long enough to be recognized by the mother. Once hormonal methods were developed to detect pregnancy earlier, the estimate of miscarriages rose to about 50%. More recent studies suggest that many fertilized eggs don't implant in the uterus or live long enough to show up on hormonal tests, bringing the estimate of miscarriages to about 80%. So — for each of us alive now — there may have been four siblings who never survived.

For those of you who experience personal losses, I can empathize with your sorrow. However, having some idea of what can go wrong, I am in almost constant awe of my own existence.

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* Adapted from Jared Diamond's "The Cruel Logic of our Genes," *Discover: Exploring the Mind*, Discover Publications, 1990, pages 24-31.