Five things research from twins taught us about health, behavior and what makes us unique

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Credit: Keisha Montfleury/Unsplash

Researchers often compare the differences between identical and fraternal twins to better understand health and behavior.

The first major insight is that genes and environments almost always combine to influence our life trajectory. Sometimes the largest factor is genetics (think genetic disorders). Sometimes it's environment (think

infections). Mostly, it's somewhere in between.

Such studies have accelerated the search for genes and environmental agents that cause or trigger diseases. This has helped us understand, treat and even prevent diseases. As twin research has matured, it has progressed to addressing important questions about when and how diseases originate.

So what has research from twins taught us about specific diseases and the human body?

1. Smoking increases the risk of bone fracture

Most studies linking environment and disease are complicated by genetic factors. To get around this, we can work with twins who differ in environmental factors.

One such Australian study from 1994 compared 20 pairs of female twins in which only one of each pair was a long-term, heavy smoker.

The researchers found smoking one pack of cigarettes a day for 20 years resulted in sufficient loss in bone density to cause osteoporosis. This doubled the risk of having a bone fracture.

This provided compelling evidence that smoking causes osteoporosis and an increased risk of bone fractures.

2. Events around the time of birth are not a major cause of epilepsy

Epilepsy is a group of disorders where brain activity is abnormal and seizures are the presenting feature. Traditionally, diagnosis was not

possible until after a person's first seizure, which can occur at any stage of life, from babies to the elderly.

Twin studies since the 1960s have shown a mix of genes and environment cause epilepsy. However, until the early 1990s, it was assumed that problems during the birthing process were a major cause of epilepsy.

Obstetricians and midwives were often blamed for causing epilepsy. However, a twin study in 1993 did not support a link between minor problems during birth and the later development of epilepsy.

This information has helped doctors and their patients better understand the causes of epilepsy and not necessarily attribute blame to the birthing process.

3. Identical twins are different under the skin from before birth

Genetically identical twins nearly always look identical. Yet, at birth, they have already accumulated differences in the structure and function of their genes.

These differences are caused by a mix of chance events and individual experiences in the womb.

The location a fertilized egg implants in the womb is random, but some locations are more favorable to growth. For the subset of identical twins who split before they reach the womb, different locations could create different environments in which a baby develops.

As a result of this or other chance events, around one in six twins differ

more than 20% in weight at birth, which may be associated with an increased risk of illness at birth, especially for the smaller twin.

Such individual experiences could also help explain Brazilian twin pairs in which only one child was born with Zika virus infection.

4. Leukemia originates before birth

Changes in the genetic sequence of blood cells can predispose people to develop leukemia (cancer of the blood).

Such changes are unique to each person but *when* these changes happened to people used to be a mystery. That was until identical twin children were discovered with leukaemias originating from the same cell.

Lymphocytes (white blood cells) of the immune system shuffle their immune genes at random, making each person genetically unique, even identical twins.

The researchers concluded the leukemia started in one twin in the womb and spread to the other twin through blood vessels in a shared placenta.

But while the first step towards leukemia happened before birth, the cancer progression differed among the twins, resulting in leukemia being diagnosed at different ages.

This provided the first evidence that some leukaemias can lay dormant for years and enabled future research that would pinpoint the events along this process.

5. Many twins don't know if they're identical or

fraternal

Identical twins start as one fertilized egg that splits after a few days. They share almost 100% of their DNA and are almost always the same sex.

Fraternal twins result from two eggs fertilized around the same time. They're as genetically different as any pair of siblings and can have the same, or different sex.

In 2012, my colleagues and I at Twins Research Australia conducted a study at a national twins festival on pairs who had any uncertainty about their genetic identity. We used "genetic fingerprinting" on DNA from cheek swabs provided by same-sex twins of all ages. This test is the definitive way of discovering whether twins are identical or fraternal.

We compared this with perceptions of the twins themselves before they took the test.

We found almost one-third of the twins we tested had been either incorrect or unsure about their genetic identity. Some had even been misinformed by medical professionals.

The universal sentiment was twins and their families felt better knowing the truth. Our data enabled us to develop better educational resources for twins and their advocates to know more about themselves.

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