



# OUCH, that hurts!

## The science of pain

Almost all of us have experienced pain of some kind. It's the most common reason why people seek medical care. But because people feel pain differently, there's no single treatment that will work for everyone.

**H**ave you ever stepped on a sharp rock, accidentally rubbed your eyes after cutting a hot pepper, or struggled through a long workday with a throbbing headache? It may feel like the pain is happening in your foot, your eye, or your head, but your brain shapes how you experience pain and how you respond to it.

Scientific research funded, conducted, and supported by NIH has changed our understanding of pain—what it is, how it works, and how we experience it.

### The many faces of pain

People experience pain in many different ways. Pain can range from the sharp feeling you get from a paper cut or a bee sting to the dull, persistent feeling of a sore muscle. In some cases, it's constant. In other cases, it comes and goes.

Pain can be acute or chronic:

- **Acute pain** is the pain you feel when you get hurt or injured. You may have experienced acute pain from an injury such as a cut or a broken limb or from disease or inflammation in the body. Acute pain can be intense and severe, but it typically resolves as your body heals from whatever caused it.
- **Chronic pain** is pain that lasts much longer—usually months and sometimes even years. Chronic pain sometimes has a clear cause, such as an acute injury, a long illness, or damage to and dysfunction of your nervous system. Sometimes it even happens without any obvious reason.

Different kinds of pain have different causes:

- **Nociceptive pain** is pain caused by tissue damage. Most acute pain is nociceptive.
- **Neuropathic pain** is caused by nerve damage or dysfunction. You can experience neuropathic pain from injuries or illness that affect the spinal cord and brain (for example, a slipped disc in your spine) or the peripheral nervous system (the nerves throughout the rest of your body). This kind of pain often feels similar to burning, shooting, or stabbing.
- **Inflammatory pain** is pain that happens when your immune system activates in response to injury or infection. In addition to causing redness or swelling, it can also make you more sensitive to feelings of pain.

## How we experience pain

When you are in pain, it's because your nervous system thinks that a part of your body is injured or in danger of getting injured (by accidentally touching a hot stove, for example). Pain is a normal sensory signal that something might be wrong and that you should do something about it. You don't become aware of pain until your brain processes it.



When a part of your body is injured, special pain receptors from that area release chemicals called neurotransmitters, which send messages to your brain.



The messages travel along nerves to the spinal cord and eventually to the brain, telling it, "Something might be wrong here, pay attention!"



Your brain receives and processes these messages, evaluates them, and decides what to do.



Your brain sends messages back to your body to react. Depending on the situation, this could mean rapidly triggering the muscles in your body to move you away from whatever is causing your pain. This reaction can feel instantaneous! If you are injured, your brain might also release natural painkillers called endorphins or tell your immune system to start healing the injury.

To see how this works, check out [this MedlinePlus video](#) on feeling pain.

## By the numbers

The estimated yearly national cost of pain, including medical treatments, disability, and lost productivity, is **\$560 billion to \$635 billion**

More than **1 in 5** adults in the United States experience chronic pain

Rates of chronic pain, including pain that severely limits work or life activities, are highest among adults **ages 65 and older**

Chronic pain conditions such as low back pain and migraine are **the leading cause** of disability around the world

**SOURCE:** [Centers for Disease Control and Prevention](#), [The American Pain Society](#), [The National Institute for Complementary and Integrative Health](#)

## How acute pain turns chronic

Most of the time, pain is a useful alarm system designed to keep us safe. But sometimes pain signals keep firing even after the body's tissues have healed.

When pain continues for a long time—such as during a long illness or after a serious injury—it can cause changes to your nervous system, which make you more sensitive to pain. This means that certain stimuli make you feel pain more quickly, and the pain can be more intense and last longer.

# OUCH!

## FAST FACT

Pain is the **most common medical complaint of older Americans**. Causes of pain in older adults include joint pain, postsurgical pain, chronic disease, and conditions associated with aging.

**SOURCE:** [THE NATIONAL INSTITUTE OF NEUROLOGICAL DISORDERS AND STROKE](#)

## Treatment

Your experience of pain is influenced by a complex set of factors that are unique to you, including your genes and biology, past experiences, emotions, and environment. That means that everyone's pain feels differently. There isn't a way to measure it objectively, and there isn't one single treatment that will work for everyone.

Working with your health care provider to understand and treat pain safely and effectively is the best approach. Your pain management will depend on the kind of pain you're experiencing and what's causing it. It often involves a combination of treatments, which may include:

- Over-the-counter and prescription medications (such as pain relievers and drugs that reduce inflammation)
- Physical and occupational therapy to improve function and limit pain
- Counseling and therapy to teach skills for coping with pain
- Medical treatments (such as medications and injections) to interrupt pain signals or change how nerves process pain
- Neuromodulation therapies (devices that stimulate nerves or the spinal cord) to reduce pain
- [Complementary and integrative therapies](#) (such as acupuncture and mindfulness meditation) ■



### FAST FACT

People born with an extremely rare genetic condition called **congenital insensitivity to pain** can't feel pain. They are able to tell the difference between hot and cold, or sharp and dull, but they can't feel the pain caused by a burn or a cut.

SOURCE: [THE GENETIC AND RARE DISEASES INFORMATION CENTER](#)

## NIH research efforts

Many NIH institutes and centers are part of the [NIH Pain Consortium](#), which works to advance pain research and promote collaboration among researchers.

The [NIH Pain Research Center](#) works to identify specific mechanisms and causes of pain in a range of conditions. The goal is to help researchers develop more effective, personalized ways to manage and treat pain, prevent chronic pain conditions, and reduce unwanted side effects such as opioid misuse and addiction.

The [Helping to End Addiction Long-term® Initiative](#), or NIH HEAL Initiative®, funds [research in pain and addiction to address the national opioid public health crisis](#). HEAL programs are led by institutes and centers across NIH. They look for scientific solutions to prevent and treat opioid misuse and addiction. They also seek to better understand and treat pain by studying the biology of pain to identify new treatment targets, conducting clinical studies to test new treatments, and working with communities to make safe, effective treatments available to everyone who needs them.

The [Back Pain Consortium \(BACPAC\) Research Program](#) is funded by the HEAL Initiative. The program conducts studies to better understand chronic low back pain, which is one of the most common chronic pain conditions. BACPAC is studying the multiple complex factors that contribute to low back pain.

The [Brain Research Through Advancing Innovative Neurotechnologies® Initiative](#), or BRAIN Initiative®, is an NIH-supported collaboration that aims to develop and apply new tools for understanding how the brain works. Scientists funded by the BRAIN Initiative are studying pain circuits in the brain to discover new ways to understand pain processing and to treat pain.