



Low Back Pain

U.S. DEPARTMENT OF HEALTH
AND HUMAN SERVICES
National Institutes of Health

Low Back Pain

If you have had lower back pain, you are not alone. Back pain is one of most common reasons people see a doctor or miss days at work. Even school-age children can have back pain.

Back pain can range in intensity from a dull, constant ache to a sudden, sharp or shooting pain. It can begin suddenly as a result of an accident or by lifting something heavy, or it can develop over time as we age. Getting too little exercise followed by a strenuous workout also can cause back pain.

There are two types of back pain:

Acute, or short-term back pain lasts a few days to a few weeks. Most low back pain is acute. It tends to resolve on its own within a few days with self-care and there is no residual loss of function. In some cases a few months are required for the symptoms to disappear.

Chronic back pain is defined as pain that continues for 12 weeks or longer, even after an initial injury or underlying cause of acute low back pain has been treated. About 20 percent of people affected by acute low back pain develop chronic low back pain with persistent symptoms at one year. Even if pain persists, it does not always mean there is a medically serious underlying cause or one that can be easily identified and treated. In some cases,

treatment successfully relieves chronic low back pain, but in other cases pain continues despite medical and surgical treatment.

What structures make up the back?

The lower back—where most back pain occurs—includes the five vertebrae (referred to as L1-L5) in the lumbar region, which supports much of the weight of the upper body. The spaces between the vertebrae are maintained by round, rubbery pads called intervertebral discs that act like shock absorbers throughout the spinal column to cushion the bones as the body moves. Bands of tissue known as ligaments hold the vertebrae in place, and tendons attach the muscles to the spinal column. Thirty-one pairs of nerves are rooted to the spinal cord and they control body movements and transmit signals from the body to the brain.

Other regions of vertebrate are cervical (in the neck), thoracic (upper back), and sacral and coccygeal (below the lumbar area) segments.

What can cause lower back pain?

Most acute low back pain is mechanical in nature, meaning that there is a disruption in the way the components of the back (the spine, muscle, intervertebral discs, and nerves) fit together and move. Some examples of mechanical causes of low back pain include:

Congenital

- **Skeletal irregularities** such as scoliosis (a curvature of the spine), lordosis (an abnormally exaggerated arch in the lower back), kyphosis (excessive outward arch of the spine), and other congenital anomalies of the spine

- **Spina bifida**, which involves the incomplete development of the spinal cord and/or its protective covering and can cause problems involving malformation of vertebrae and abnormal sensations and even paralysis

Injuries

- **Sprains** (overstretched or torn ligaments), **strains** (tears in tendons or muscle), and **spasms** (sudden contraction of a muscle or group of muscles)
- **Traumatic injury**, such as from playing sports, car accidents, or a fall that can injure tendons, ligaments, or muscle causing the pain, as well as compress the spine and cause discs to rupture or herniate

Degenerative problems

- **Intervertebral disc degeneration**, which occurs when the usually rubbery discs wear down as a normal process of aging and lose their cushioning ability
- **Spondylosis**, the general degeneration of the spine associated with normal wear and tear that occurs in the joints, discs, and bones of the spine as people get older
- **Arthritis or other inflammatory disease** in the spine, including osteoarthritis and rheumatoid arthritis as well as spondylitis, an inflammation of the vertebrae

Nerve and spinal cord problems

- **Spinal nerve compression, inflammation and/or injury**
- **Sciatica** (also called radiculopathy), caused by something pressing on the sciatic nerve that travels through the buttocks and extends down

the back of the leg. People with sciatica may feel shock-like or burning low back pain combined with pain through the buttocks and down one leg.

- **Spinal stenosis**, the narrowing of the spinal column that puts pressure on the spinal cord and nerves
- **Spondylolisthesis**, which happens when a vertebra of the lower spine slips out of place, pinching the nerves exiting the spinal column
- **Herniated or ruptured discs** can occur when the intervertebral discs become compressed and bulge outward
- **Infections** involving the vertebrae, a condition called osteomyelitis; the intervertebral discs, called discitis; or the sacroiliac joints connecting the lower spine to the pelvis, called sacroiliitis
- **Cauda equina syndrome** occurs when a ruptured disc pushes into the spinal canal and presses on the bundle of lumbar and sacral nerve roots. Permanent neurological damage may result if this syndrome is left untreated.
- **Osteoporosis** (a progressive decrease in bone density and strength that can lead to painful fractures of the vertebrae)

Non-spine sources

- **Kidney stones** can cause sharp pain in the lower back, usually on one side
- **Endometriosis** (the buildup of uterine tissue in places outside the uterus)
- **Fibromyalgia** (a chronic pain syndrome involving widespread muscle pain and fatigue)
- **Tumors** that press on or destroy the bony spine or spinal cord and nerves or outside the spine elsewhere in the back

- **Pregnancy** (back symptoms almost always completely go away after giving birth)

What are the risk factors for developing low back pain?

Anyone can have back pain. Factors that can increase the risk for low back pain include:

Age: The first attack of low back pain typically occurs between the ages of 30 and 50, and back pain becomes more common with advancing age. Loss of bone strength from osteoporosis can lead to fractures, and at the same time, muscle elasticity and tone decrease. The intervertebral discs begin to lose fluid and flexibility with age, which decreases their ability to cushion the vertebrae. The risk of spinal stenosis also increases with age.

Fitness level: Back pain is more common among people who are not physically fit. Weak back and abdominal muscles may not properly support the spine. “Weekend warriors”—people who go out and exercise a lot after being inactive all week—are more likely to suffer painful back injuries than people who make moderate physical activity a daily habit. Studies show that low-impact aerobic exercise can help maintain the integrity of intervertebral discs.

Weight gain: Being overweight, obese, or quickly gaining significant amounts of weight can put stress on the back and lead to low back pain.

Genetics: Some causes of back pain, such as ankylosing spondylitis (a form of arthritis that involves fusion of the spinal joints leading to some immobility of the spine), have a genetic component.

Job-related factors: Having a job that requires heavy lifting, pushing, or pulling, particularly when it involves twisting or vibrating the spine, can lead to injury and back pain. Working at a desk all day can contribute to pain, especially from poor posture or sitting in a chair with not enough back support.

Mental health: Anxiety and depression can influence how closely one focuses on their pain as well as their perception of its severity. Pain that becomes chronic also can contribute to the development of such psychological factors. Stress can affect the body in numerous ways, including causing muscle tension.

Smoking: It can restrict blood flow and oxygen to the discs, causing them to degenerate faster.

Backpack overload in children: A backpack overloaded with schoolbooks and supplies can strain the back and cause muscle fatigue.

Psychological factors: Mood and depression, stress, and psychological well-being also can influence the likelihood of experiencing back pain.

How is low back pain diagnosed?

A complete medical history and physical exam can usually identify any serious conditions that may be causing the pain. Neurologic tests can help determine the cause of pain and appropriate treatment. Imaging tests are not needed in most cases but may be ordered to rule out specific causes of pain, including tumors and spinal stenosis. Occasionally the cause of chronic lower back pain is difficult to determine even after a thorough examination.

Tests include:

Blood tests are not routinely used to diagnose the cause of back pain but might be ordered to look for signs of inflammation, infection, cancer, and/or arthritis.

Bone scans can detect and monitor an infection, fracture, or bone disorder. A small amount of radioactive material is injected into the bloodstream and collects in the bones, particularly in areas with some abnormality. Scanner-generated images can identify specific areas of irregular bone metabolism or abnormal blood flow, as well as to measure levels of joint disease.

Discography involves injecting a contrast dye into a spinal disc thought to be causing low back pain. The fluid's pressure in the disc will reproduce the person's symptoms if the disc is the cause. The dye helps to show the damaged areas on CT scans taken following the injection.

Electrodiagnostics can identify problems related to the nerves in the back and legs.

The procedures include:

- **electromyography (EMG)** assesses the electrical activity in a muscle and can detect if muscle weakness results from a problem with the nerves that control the muscles. Very fine needles are inserted in muscles to measure electrical activity transmitted from the brain or spinal cord to a particular area of the body.
- **evoked potential** studies involve two sets of electrodes—one set to stimulate a sensory nerve, and the other placed on the scalp to record the speed of nerve signal transmissions to the brain.
- **nerve conduction studies (NCS)** also use two sets of electrodes to stimulate the nerve that runs

to a particular muscle and record the nerve's electrical signals to detect any nerve damage.

Diagnostic imaging tests allow specialists to see into the body without having to perform exploratory surgery. Imaging includes:

- **Computerized tomography (CT)** can show soft tissue structures that cannot be seen on conventional x-rays, such as disc rupture, spinal stenosis, or tumors.
- **Magnetic resonance imaging (MRI)** creates a computer-generated image of bony structures and soft tissues such as muscles, ligaments, tendons, and blood vessels. An MRI may be ordered if a problem such as infection, tumor, inflammation, disc herniation or rupture, or pressure on a nerve is suspected.
- **X-ray imaging** can show broken bones or an injured or misaligned vertebra.

Myelograms enhance the diagnostic imaging of x-rays and CT scans. In this procedure, a contrast dye is injected into the spinal canal, allowing spinal cord and nerve compression caused by herniated discs or fractures to be seen on an x-ray or CT scans.

How is back pain treated?

Acute back pain usually gets better on its own. Acute back pain is usually treated with:

- **Medications** designed to relieve pain and/or inflammation
 - **analgesics** such as acetaminophen and aspirin
 - **non-steroidal anti-inflammatory drugs (NSAIDs)** such as ibuprofen and naproxen—

may be sold over the counter; some NSAIDS are prescribed by a physician

- **muscle relaxants** are prescription drugs that are used on a short-term basis to relax tight muscles
- **topical pain relief** such as creams, gels, patches, or sprays applied to the skin stimulate the nerves in the skin to provide feelings of warmth or cold in order to dull the sensation of pain. Common topical medications include capsaicin and lidocaine.
- **Heat and/or ice** may help ease pain, reduce inflammation, and improve mobility for some people
- **Gentle stretching** (not vigorous exercise) upon advice by your healthcare professional

Exercising, bed rest, and surgery are typically not recommended for acute back pain.

Chronic back pain is most often treated with a stepped care approach, moving from simple low-cost treatments to more aggressive approaches. Specific treatments may depend on the identified cause of the back pain.

Step 1 Early treatments

Medications may include:

- **Analgesics and NSAIDS**
- **Opioid drugs** prescribed by a physician (opioids should be used only for a short period of time and under a physician's supervision, as opioids can be addictive, aggravate depression, and have other side effects)

- **Anticonvulsants**—prescribed drugs primarily used to treat seizures—may be useful in treating people with sciatica
- **Antidepressants** such as tricyclics and serotonin, and norepinephrine reuptake inhibitors have been commonly prescribed for chronic low back pain (prescribed by a physician)

Self-management:

- **Hot or cold packs**
- **Resuming normal activities** as soon as possible may ease pain; bed rest is not recommended
- **Exercises** that strengthen core or abdominal muscles may help to speed recovery from chronic low back pain. Always check first with a physician before starting an exercise program and to get a list of helpful exercises.

Step 2 Complementary and alternative techniques include:

- **Acupuncture** is moderately effective for chronic low back pain. It involves inserting thin needles into precise points throughout the body and stimulating them (by twisting or passing a low-voltage electrical current through them), which may cause the body to release naturally occurring painkilling chemicals such as endorphins, serotonin, and acetylcholine.
- **Behavioral approaches** include:
 - **Biofeedback** involves attaching electrodes to the skin and using an electromyography machine that allows people to become aware of and control their breathing, muscle tension, heart rate, and skin temperature; people regulate their response to pain by using relaxation techniques

- **cognitive therapy** involves using relaxation and coping techniques to ease back pain
- **Transcutaneous electrical nerve stimulation (TENS)** involves wearing a battery-powered device which places electrodes on the skin over the painful area that generate electrical impulses designed to block or modify the perception of pain
- **Physical therapy** programs to strengthen core muscle groups that support the low back, improve mobility and flexibility, and promote proper positioning and posture are often used in combination with other interventions
- **Spinal manipulation and spinal mobilization** are approaches in which doctors of chiropractic care use their hands to mobilize, adjust, massage, or stimulate the spine and the surrounding tissues. Manipulation involves a rapid movement over which the individual has no control; mobilization involves slower adjustment movements. The techniques may provide small to moderate short-term benefits in people with chronic low back pain but neither technique is appropriate when a person has an underlying medical cause for the back pain such as osteoporosis, spinal cord compression, or arthritis.

Spinal injections include:

- *Trigger point injections* can relax knotted muscles (trigger points) that may contribute to back pain. An injection or series of injections of a local anesthetic and often a corticosteroid drug into the trigger point(s) can lessen or relieve pain.

- *Epidural steroid injections* into the lumbar area of the back are given to treat low back pain and sciatica associated with inflammation. Pain relief associated with the injections tends to be temporary and the injections are not advised for long-term use.
- *Radiofrequency ablation* involves inserting a fine needle into the area causing the pain through which an electrode is passed and heated to destroy nerve fibers that carry pain signals to the brain. Also called a rhizotomy, the procedure can relieve pain for several months.
- **Traction** involves the use of weights and pulleys to apply constant or intermittent force to gradually “pull” the skeletal structure into better alignment. Some people experience pain relief while in traction but the back pain tends to return once the traction is released.

Step 3 More advanced care options

Surgery

When other therapies fail, surgery may be considered to relieve pain caused by worsening nerve damage, serious musculoskeletal injuries, or nerve compression. Specific surgeries are selected for specific conditions/indications. However, surgery is not always successful. It may be months following surgery before the person is fully healed and there may be permanent loss of flexibility. Surgical options include:

- **Vertebroplasty and kyphoplasty** for fractured vertebra are minimally invasive treatments to repair compression fractures of the vertebrae caused by osteoporosis. Vertebroplasty uses three-dimensional imaging to assist in guiding

a fine needle through the skin into the vertebral body, the largest part of the vertebrae. A glue-like bone cement is then injected into the vertebral body space, which quickly hardens to stabilize and strengthen the bone and provide pain relief. In kyphoplasty, prior to injecting the bone cement, a special balloon is inserted and gently inflated to restore height to the vertebral structure and reduce spinal deformity.

- **Spinal laminectomy** (also known as spinal decompression) is done when a narrowing of the spinal canal causes pain, numbness, or weakness. During the procedure, the lamina or bony walls of the vertebrae are removed, along with any bone spurs, to relieve pressure on the nerves.
- **Discectomy and microdiscectomy** involve removing a herniated disc through an incision in the back (microdiscectomy uses a much smaller incision in the back and allows for a more rapid recovery). Laminectomy and discectomy are frequently performed together and the combination is one of the more common ways to remove pressure on a nerve root from a herniated disc or bone spur.
- **Foraminotomy** is an operation that “cleans out” or enlarges the bony hole (foramen) where a nerve root exits the spinal canal. Bulging discs or joints thickened with age can narrow the space where the spinal nerve exits and press on the nerve. Small pieces of bone over the nerve are removed through a small slit, allowing the surgeon to cut away the blockage and relieve pressure on the nerve.
- **Nucleoplasty**, also called plasma disc decompression (PDD), is a type of laser surgery that uses radiofrequency energy to treat people with

low back pain associated with mildly herniated discs. Under x-ray guidance, a needle is inserted into the disc. A plasma laser device is then inserted into the needle and the tip is heated to 40-70 degrees Celsius, creating a field that vaporizes the tissue in the disc, reducing its size and relieving pressure on the nerves.

- **Radiofrequency denervation** uses electrical impulses to interrupt nerve conduction (including pain signaling). Using x-ray guidance, a needle is inserted into a target area of nerves and the region is heated, which destroys part of the target nerves and offers temporary pain relief.
- **Spinal fusion** is used to strengthen the spine and prevent painful movements in people with degenerative disc disease or spondylolisthesis (following laminectomy). The spinal disc between two or more vertebrae is removed and the adjacent vertebrae are “fused” by bone grafts and/or metal devices secured by screws. Spinal fusion may result in some loss of flexibility in the spine and requires a long recovery period to allow the bone grafts to grow and fuse the vertebrae together. Spinal fusion has been associated with an acceleration of disc degeneration at adjacent levels of the spine.
- **Artificial disc replacement** is an alternative to spinal fusion for treating severely damaged discs. The procedure involves removing the disc and replacing it with a synthetic disc that helps restore height and movement between the vertebrae.
- **Interspinous spacers** are small devices that are inserted into the spine to keep the spinal canal open and avoid pinching the nerves. It is used to treat people with spinal stenosis.

Implanted nerve stimulators

- **Spinal cord stimulation** uses low-voltage electrical impulses from a small implanted device that is connected to a wire that runs along the spinal cord. The impulses are designed to block pain signals that are normally sent to the brain.
- **Dorsal root ganglion stimulation** also involves electrical signals sent along a wire connected to a small device that is implanted into the lower back. It specifically targets the nerve fibers that transmit pain signals. The impulses are designed to replace pain signals with a less painful numbing or tingling sensation.
- **Peripheral nerve stimulation** also uses a small implanted device and an electrode to generate and send electrical pulses that create a tingling sensation to provide pain relief.

Rehabilitation programs

Rehabilitation teams use a mix of healthcare professionals from different specialties and disciplines to develop programs of care that help people live with chronic pain. The programs are designed to help the individual reduce pain and reliance on opioid pain medicines. Programs last usually two to three weeks and can be done on an in-patient or out-patient basis.

Can back pain be prevented?

Recurring back pain resulting from improper body mechanics may be prevented by avoiding movements that jolt or strain the back, maintaining correct posture, and lifting objects properly. Many work-related injuries are caused or aggravated by stressors such as

heavy lifting, contact stress (repeated or constant contact between soft body tissue and a hard or sharp object), vibration, repetitive motion, and awkward posture.

Recommendations for keeping one's back healthy

- Exercise regularly to keep muscles strong and flexible. Consult a physician for a list of low-impact, age-appropriate exercises that are specifically targeted to strengthening lower back and abdominal muscles.
- Maintain a healthy weight and eat a nutritious diet with sufficient daily intake of calcium, phosphorus, and vitamin D to promote new bone growth.
- Use ergonomically designed furniture and equipment at home and at work. Make sure work surfaces are at a comfortable height.
- Switch sitting positions often and periodically walk around the office or gently stretch muscles to relieve tension. A pillow or rolled-up towel placed behind the small of the back can provide some lumbar support. Put your feet on a low stool or a stack of books when sitting for a long time.
- Wear comfortable, low-heeled shoes.
- Sleeping on one's side with the knees drawn up in a fetal position can help open up the joints in the spine and relieve pressure by reducing the curvature of the spine. Always sleep on a firm surface.
- Don't try to lift objects that are too heavy. Lift from the knees, pull the stomach muscles in, and keep the head down and in line with a straight back. When lifting, keep objects close to the body. Do not twist when lifting.

- **Quit smoking.** Smoking reduces blood flow to the lower spine, which can contribute to spinal disc degeneration. Smoking also increases the risk of osteoporosis and impedes healing. Coughing due to heavy smoking also may cause back pain.

What research is being done?

The mission of the National Institute of Neurological Disorders and Stroke (NINDS) is to seek fundamental knowledge of the brain and nervous system and to use that knowledge to reduce the burden of neurological disease. NINDS is a component of the National Institutes of Health (NIH), the leading supporter of biomedical research in the world.

As a primary supporter of research on pain and pain mechanisms, NINDS is a member of the *NIH Pain Consortium*, which was established to promote collaboration among the many NIH Institutes and Centers with research programs and activities addressing pain. On an even broader scale, NIH participates in the *Interagency Pain Research Coordinating Committee*, a federal advisory committee that coordinates research across other U.S. Department of Health and Human Services agencies as well as the Departments of Defense and Veterans Affairs.

The NIH HEAL (Helping to End Addiction Long-term) Initiative, launched in April 2018, is a trans-NIH effort (of which NINDS co-leads) that aims to prevent opioid addiction and provide more non-drug treatment options for chronic pain. Back pain is one of the most common pain conditions world-wide and is a major contributor to the prescribing and use of

opioids in America. The treatment of low back pain is a specific area of focus of the Initiative. The Back Pain Consortium established through HEAL will conduct studies to better understand the mechanisms of common pain conditions such as chronic low back pain, develop improved diagnostic and treatment tools, and identify, prioritize, and test therapies that reduce the need for opioid use for millions of Americans. For more about the HEAL Initiative, see <https://www.nih.gov/heal-initiative>.

NINDS-funded studies are contributing to a better understanding of why some people with acute low back pain recover fully while others go on to develop chronic low back pain. Brain imaging studies suggest that people with chronic low back pain have changes in the structure and function of certain brain regions. Other research seeks to determine the role of brain circuits important for emotional and motivational learning, and memory in this transition, in order to identify new preventive interventions. Furthermore, several studies are being conducted to identify and characterize bidirectional neural circuits that communicate between the spinal cord to brain, which are aimed at discovering and validating new interventional targets for low back pain.

Different studies are looking at the response to placebos in individuals with acute and chronic back pain. For example, one study is designed to examine brain properties for placebo response and critically assess the neurobiology of placebo pain relief for individuals with chronic pain. Another study is assessing ibuprofen plus acetaminophen compared to ibuprofen plus placebo in treating acute low back pain.

In addition to NINDS, other NIH Institutes—including the National Institute on Arthritis and Musculoskeletal and Skin Diseases, the National Institute on Drug Abuse, and the National Center on Complementary and Integrative Health—fund research on low back pain. More information on NIH efforts on back pain research and on other disorders can be found using NIH RePORTER (<http://projectreporter.nih.gov>), a searchable database of current and past research projects supported by NIH and other federal agencies. RePORTER also includes links to publications and patents citing support from these projects.

Where can I get more information?

For information about neurological disorders or research programs funded by the National Institute of Neurological Disorders and Stroke (NINDS), contact the Institute's Brain Resources and Information Network (BRAIN) at:

BRAIN

P.O. Box 5801
Bethesda MD 20824
800-352-9424
www.ninds.nih.gov

Information on back pain also is available from the following organizations:

American Academy of Family Physicians

11400 Tomahawk Creek Parkway
Leawood, KS 66211-2680
913-906-6000 or 800-274-2237
www.aafp.org

American Academy of Orthopaedic Surgeons

9400 West Higgins Road

Rosemont, IL 60018

847-823-8125

<https://aaos.org>

American Academy of Physical Medicine & Rehabilitation

9700 West Bryn Mawr Avenue

Suite 200

Rosemont, IL 60018

847-737-6000

www.aapmr.org

American Association of Neurological Surgeons

5550 Meadowbrook Drive

Rolling Meadows, IL 60008-3852

847-378-0500 or 888-566-2267

www.aans.org

American Chronic Pain Association (ACPA)

P.O. Box 850

Rocklin, CA 95677-0850

800-533-3231

<https://theacpa.org>

National Institute of Arthritis and Musculoskeletal and Skin Diseases Information Clearinghouse

1 AMS Circle

Bethesda, MD 20892-3675

301-495-4484 or 877-226-4267;

301-565-2966 (TTY)

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