National Institute of Neurological Disorders and Stroke

Amyotrophic Lateral Sclerosis (ALS)

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What is amyotrophic lateral sclerosis (ALS)?

Amyotrophic lateral sclerosis (ALS), formerly known as Lou Gehrig's disease, is a neurological disorder that affects motor neurons. Motor neurons are the nerve cells in the brain and spinal cord that control voluntary muscle movement and breathing.

As motor neurons degenerate and die, they stop sending messages to the muscles. This causes the muscles to weaken, start to twitch (fasciculations), and waste away (atrophy). Eventually, in people with ALS, the brain loses its ability to start and control voluntary movements such as walking, talking, chewing and other functions, as well as breathing. ALS is progressive, meaning symptoms get worse over time.

The U.S. Food and Drug Administration (FDA) has approved several drugs for ALS that may prolong survival, reduce the rate of decline, or help manage symptoms. But there's currently no known treatment that stops or reverses the progression of ALS.

Early symptoms include:

- Muscle twitches in the arm, leg, shoulder, or tongue
- Muscle cramps
- Tight and stiff muscles (spasticity)
- Muscle weakness affecting an arm, a leg, or the neck
- Slurred and nasal speech
- Difficulty chewing or swallowing

As the disorder progresses, muscle weakness and atrophy spread to other parts of the body. People with ALS may develop problems with:

- Chewing food and swallowing (dysphagia)
- Drooling (sialorrhea)
- Speaking or forming words (dysarthria)
- Breathing (dyspnea)
- Unintended crying, laughing, or other emotional displays (pseudobulbar symptoms)
- Constipation
- Maintaining a healthy weight and getting enough nutrients

Eventually, people with ALS become unable to stand or walk, get in or out of bed on their own, use their hands and arms, or breathe on their own. Because they usually remain able to reason, remember, and understand, they are aware of their progressive loss of function. This can cause anxiety and depression in the person with ALS and their loved ones. Although not as common, people with ALS also may experience problems with language or decision-making. Some also develop a form of dementia known as FTD-ALS.

Most people with ALS die from being unable to breathe on their own (known as respiratory failure), usually within three to five years of symptoms first appearing. But about 1 in 10 people survive for 10 years or more.

Who is more likely to get ALS?

A risk factor is a condition or behavior, like high blood pressure or smoking, that increases the likelihood of having a certain health problem compared to those who don't have the risk factor. Having a risk factor doesn't mean a person will develop ALS, and not having a risk factor doesn't mean they won't. Risk factors for ALS include:

- **Age:** Although ALS can happen at any age, symptoms most commonly develop between the ages of 55 and 75.
- **Biological sex:** Men are slightly more likely to develop ALS than women. But at older ages, men and women are equally likely to be diagnosed with ALS.
- **Race and ethnicity:** White people, particularly non-Hispanic White people, are most likely to develop ALS, but it affects people of all races and ethnicities.

Some studies suggest military veterans are about one and a half to two times more likely to develop ALS, although the reason for this is unclear. Possible risk factors for veterans include exposure to lead, pesticides, and other environmental toxins. Some studies have also shown that head injury can be associated with higher risk for ALS, but more research is needed to understand this connection.

Sporadic and familial ALS

Nearly all cases of ALS are considered sporadic, meaning the disorder seems to happen at random with no clearly associated risk factors and no family history. Although family members of people with ALS are at an increased risk for the disorder, the overall risk is very low—most won't develop ALS.

About 10% of all ALS cases are familial (also called inherited or genetic). Mutations (changes) in more than a dozen genes have been found to cause familial ALS. For example:

- Mutations in the C9orf72 gene cause about 25% to 40% of all familial cases (and a small amount of sporadic cases). C9orf72 makes a protein found in motor neurons and nerve cells in the brain.
- Mutations in the SOD1 gene cause another 12% to 20% of familial cases. SOD1 is involved in production of the enzyme copper-zinc superoxide dismutase 1.

In 2021, a team of scientists led by the National Institutes of Health and the Uniformed Services University of the Health Sciences announced it had discovered a unique form of genetic ALS that affects children as young as 4 years. This childhood form is linked to the gene SPTLC1 that is part of the body's fat production system and may be caused by changes in the way the body uses fatty materials (lipids).

How is ALS diagnosed and treated?

Diagnosing ALS

It's important to get an accurate ALS diagnosis as soon as possible. ALS treatments may be most effective soon after symptoms start. A neurologist familiar with ALS can help a person get diagnosed early.

There is no single test that can definitely diagnose ALS. A doctor will conduct a physical exam and review the person's full medical history. A neurologic examination will test reflexes, muscle strength, and other responses. These tests should be performed at regular intervals to assess whether symptoms are getting worse over time.

A doctor may conduct muscle and imaging tests to rule out other disorders. This can help support an ALS diagnosis. One test is magnetic resonance imaging (MRI), which uses a magnetic field and radio waves to produce detailed images of the brain and spinal cord. Another is electromyography (EMG), which evaluates how well nerves and muscles are functioning. An EMG can include:

- A nerve conduction study (NCS), which measures the electrical activity of nerves and muscles by assessing the nerve's ability to send a signal along the nerve or to the muscle.
- A needle exam, which is a recording technique that detects electrical activity in muscle fibers using a needle electrode.

Other tests can rule out the possibility of other disorders. They can include:

- Blood and urine tests
- A spinal tap (lumbar puncture) to test the person's cerebrospinal fluid (CSF)
- Muscle biopsy

Find out more about neurological diagnostic tests and procedures.

Treating ALS

There's no treatment to reverse damage to motor neurons or cure ALS at this time. But some treatments may slow progression of the disorder, improve quality of life, and extend survival. New treatments have become available in the past several years, and researchers continue to explore different options to slow or stop progression of ALS.

Integrated, multi-disciplinary teams of professionals are best prepared to provide supportive health care. These teams can design an individualized treatment plan and provide special equipment aimed at keeping people as mobile, comfortable, and independent as possible. They may include:

- Physicians
- Pharmacists
- Physical, occupational, speech, and respiratory therapists
- Nutritionists
- Social workers
- Clinical psychologists
- Home care and hospice nurses

Doctors may use the following medicines approved by the FDA to support a treatment plan for ALS:

- Riluzole (Rilutek) is an oral medicine believed to reduce damage to motor neurons by decreasing levels of glutamate, which carries messages between nerve cells and motor neurons. Clinical trials in people with ALS showed that riluzole may extend survival by a few months. The thickened liquid form (Tiglutik) or the tablet (Exservan) that dissolves on the tongue may be better than the pill form for people that have problems with swallowing.
- Edaravone (Radicava) is an antioxidant given either orally or intravenously (through an IV) and has been shown to slow functional decline in some people with ALS. Radicava ORS is a form of edaravone that can be taken orally or through a feeding tube.
- Tofersen (Qalsody) is given through a spinal injection to people with ALS who have been confirmed to have a mutation in the SOD1 gene. While the benefits of this drug are still under study, it may work by decreasing one of the causes of damage to neurons.

Sodium phenylbutyrate/taurursodiol (Relyvrio) is an oral medicine that was proposed to prevent nerve cell death by blocking stress signals in cells. The FDA approved Relyvrio based on safety and efficacy data from a single, smaller ALS clinical trial in September 2022. But a larger clinical trial failed to confirm the earlier findings, and the manufacturer of Relyvrio removed the drug from the market in 2024.

A doctor may prescribe other medicines or treatments to help manage symptoms—including muscle cramps and stiffness, excessive saliva and phlegm, and unwanted episodes of crying, laughing, or other emotional displays. Medicines may also help with any pain, depression, sleep problems, or constipation.

Rehabilitation, therapy, and other support

A treatment plan for ALS usually includes rehabilitation, which should be tailored to the person's individual needs. It may include physical, occupational, and speech therapy.

Support for physical function and daily life

Physical therapy can help people with ALS maintain function and movement. This includes lowering their risk of falls and joint pain and maximizing their independence at different stages of the disorder. Low-impact exercises such as walking, swimming, or using a stationary exercise bike—along with range of motion exercises—can help maintain muscle strength and function.

Occupational therapists can help with daily living and self-care activities. They can also suggest assistive devices for feeding, bathing, and grooming so that the person can be as independent as possible.

Speech and communication support

Speech therapists can help people with ALS learn strategies to speak louder and more clearly—and help maintain the ability to communicate. Computer-based speech synthesizers use eye-tracking devices that allow a person to use the internet and to type on custom screens to communicate. People with ALS sometimes use voice banking, a process that stores their own voice for future use in computer-based speech synthesizers.

A brain-computer interface (BCI) is a system that allows people to communicate or control equipment such as a wheelchair using only brain activity. Researchers are developing more efficient, mobile BCIs for people with severe paralysis or visual impairments.

Support for nutrition, breathing, and feeding

People with ALS may have trouble chewing and swallowing their food, and getting the nutrients they need. Nutritionists and registered dieticians can help plan small, nutritious meals throughout the day—and identify foods to avoid. When the person can no longer eat with help, a feeding tube can reduce the person's risk of choking and pneumonia.

As the muscles responsible for breathing start to weaken, people with ALS may have shortness of breath during physical activity and difficulty breathing at night or when lying down. Noninvasive ventilation (NIV) is a type of breathing support that is usually delivered through a mask over the nose, mouth, or both. It may help decrease the discomfort some people with ALS experience while breathing. At first, NIV may only be necessary at night, but people may eventually need it full time. As the disorder progresses, the person may need the support of respirators (mechanical ventilators) to breathe.

Because the muscles that control breathing become weak, people with ALS also may have trouble creating a strong cough—which can help clear the throat. There are several techniques to increase forceful coughing, including mechanical cough assistive devices.

Caring for a person living with ALS

As ALS progresses, people need more and more help with daily activities. Being a caregiver for a person with ALS, while rewarding, can be challenging. It's important for caregivers to take care of themselves and to seek support when needed. Free and paid resources are available to provide home health care services and support. Visit the organizations listed at the end of this resource to find support in your area.

What are the latest updates on ALS?

NINDS, a part of the National Institutes of Health (NIH), is the primary federal funder of research on the brain and nervous system, including disorders such as ALS. In 2023, NINDS published strategic priorities for ALS research to accelerate the development of effective interventions for the diagnosis, treatment, management, prevention, and cure of ALS. Scientists, clinicians, advocates, people affected by ALS, and the public provided input for the development of these strategic priorities. Under the Accelerating Access to Critical Therapies for ALS Act, NINDS also funds research on expanded access for investigational new drugs to people living with ALS who aren't eligible for clinical trials.

Scientific discoveries have resulted in the identification of multiple therapeutic targets for ALS. The FDA has approved one symptom-managing and four disorder-modifying ALS therapies, but the impact of these disorder-modifying therapies is modest. To develop truly effective ALS treatments, we must address many challenges. The goals of NINDS's ALS research are to:

- Understand the cellular mechanisms involved in the development and progression of the disorder
- Investigate the influence of genetics and other potential risk factors
- Identify biomarkers (biological measures of a disorder)
- Develop new treatments

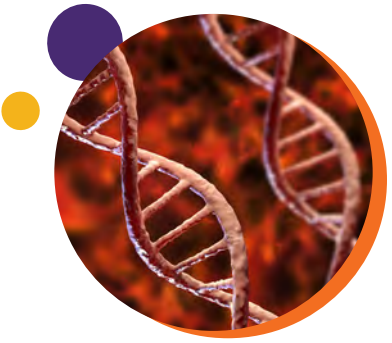
Cellular defects

Ongoing studies seek to understand the mechanisms that selectively trigger motor neurons to degenerate in ALS, which may lead to effective approaches to stop this process. Research using cellular culture systems and animal models suggests that motor neuron death is caused by a variety of cellular defects. This includes defects involved in protein recycling and gene regulation, as well as structural impairments in motor neurons. Increasing evidence also suggests that glial support cells and inflammation cells of the nervous system may play an important role in ALS.

Stem cells

Scientists are turning adult skin and blood cells into stem cells that are capable of becoming any cell type, including motor neurons and other cells which may be involved in ALS. NINDS-funded scientists are using stem cells to grow human spinal cord sections on tissue chips to help better understand the function of neurons involved in ALS.

Genetics and epigenetics



Clinical research studies supported by NINDS are looking into how ALS symptoms change over time in people with C9orf72 mutations. Other studies are working to identify additional genes that may cause or put a person at risk for either familial or sporadic ALS.

A large-scale collaborative research effort supported by NINDS, other NIH institutes, and several public and private organizations is analyzing genetic data from thousands of people with ALS to

discover new genes involved in the disorder. By using novel gene sequencing tools, researchers are now able to rapidly identify new genes in the human genome involved in ALS and other neurodegenerative disorders. People who carry genes associated with ALS may be able to participate in long-term, observational studies to help researchers understand how the disorder progresses over time in different populations.

Additionally, researchers are looking at the potential role of epigenetics in ALS development. Epigenetic changes can switch genes on and off during a person's lifetime, which can greatly impact both health and disease. Although this research is exploratory, scientists hope that understanding epigenetics can offer new information about how ALS develops.

Biomarkers

NINDS supports research on the development of biomarkers, biological signs of disease that can be found and measured. Tests can detect biomarkers in a person's blood, through brain scans, or in other ways. They can show whether a person has a disease or condition and how it's progressing over time. ALS biomarkers can help identify the rate of progression and the effectiveness of current and future therapies.

For more information on research about ALS, check NIH RePORTER, a searchable database of current and past research projects funded by NIH and other federal agencies. RePORTER also has links to publications and resources from these projects.

For research articles and summaries on ALS, search PubMed, which contains citations from medical journals and other sites.

How can I or my loved one help improve care for people with ALS?

The Center for Disease Control and Prevention developed the National ALS Registry. The Registry collects, manages, and analyzes de-identified data about people with ALS in the U.S. It establishes information about the number of ALS cases, collects demographic, occupational, and environmental exposure data from people with ALS to learn about potential risk factors for the disorder, and notifies participants about research opportunities. The Registry includes data from national databases as well as de-identified information provided by people with ALS. All information is kept confidential. People with ALS can add their information to the registry and sign up to receive more information.

Consider participating in a clinical trial so clinicians and scientists can learn more about ALS and related disorders. Clinical research with human study participants helps researchers learn more about a disorder and perhaps find better ways to safely detect, treat, or prevent disease.

All types of study participants are needed—those who are healthy or may have an illness or disease—of all different ages, sexes, races, and ethnicities to ensure that study results apply to as many people as possible, and that treatments will be safe and effective for everyone who will use them.

For information about participating in clinical research, visit the NINDS Clinical Trials site and NIH Clinical Research Trials and You.

Learn about clinical trials currently looking for people with ALS at ClinicalTrials.gov, a searchable database of current and past clinical studies and research results.

NINDS also supports the NIH NeuroBioBank, a collaborative effort involving several brain banks across the U.S. that supply investigators with tissue from people with neurological and other disorders. Tissue from people with ALS is needed to help advance critical research on the disorder. A single donated brain can make a huge impact on ALS research, potentially providing information for hundreds of studies. The goal is to increase the availability of, and access to, high quality specimens for research to understand the neurological basis of the disorder. Potential donors can begin the enrollment process by visiting Learn How to Become a Brain Donor.

Where can I find more information about ALS?

Information may be available from the following sources:

ALS Therapy Development Institute
617-441-7200

Genetic and Rare Diseases (GARD) Information Center
888-205-2311

Eldercare Locator
800-677-1116

I AM ALS
866-942-6257

Les Turner ALS Foundation
847-679-3311

MedlinePlus

Muscular Dystrophy Association
800-572-1717

National ALS Registry

Project ALS
212-420-7382

The ALS Association
800-782-4747

Learn more about related topics

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