

Understanding Alzheimer's Disease Genes

Learn About

- What Are Genes?
- Do Genes Cause Disease?
- Does Alzheimer's Run in the Family?
- What Genes Are Related to Alzheimer's?
- Is Genetic Testing an Option?
- Joining an Alzheimer's Research Study

Many people wonder if Alzheimer's disease runs in their family. Is it in your genes? This question isn't easy to answer. Researchers have identified several genetic variants that are associated with Alzheimer's and may increase or decrease a person's risk of developing the disease. To better understand what that may mean for you, it's important to learn more about what genes are and what they do.

What Are Genes?

Human cells contain the instructions needed for the cell to do its job. These instructions are made up of DNA, which is packed tightly into structures called chromosomes. Each chromosome has thousands of segments called genes.

Genes carry information that defines traits like eye color, and also plays a role in health. They are passed down from a

person's biological parents. Variations in genes — even small ones — can affect the likelihood of developing a disease, such as Alzheimer's.

Do Genes Cause Disease?

Permanent changes in one or more specific genes are called genetic variants. Some variants are common among people. Most genetic variants don't cause diseases, but some do. Other variants may simply increase, or even decrease, a person's risk of developing a disease.

Lifestyle factors, such as exercise, diet, chemicals, or smoking, can have positive or negative health effects on genes by changing the way certain genes work.

Knowing more about the role of genes can make it easier to understand what a person's risk for Alzheimer's may be and what factors may influence that risk.

Does Alzheimer's Run in the Family?

Many people worry about developing Alzheimer's, especially if a family member has been diagnosed with it.

In most cases, Alzheimer's does not have a single genetic cause. Instead, it can be influenced by multiple genes in combination with lifestyle and environmental factors. A person may carry more than one gene or group of genes that can either increase or reduce the risk of Alzheimer's.

People who develop Alzheimer's do not always have a history of the disease in their families. But those who have a parent or sibling diagnosed with the disease do have a higher risk of developing Alzheimer's than those who don't.

Which Genes Are Related to Alzheimer's?

Ten years ago, researchers knew of only 10 genes linked with Alzheimer's. Scientists currently know of more than 70 genetic regions associated with Alzheimer's. Of those, scientists have identified rare genetic variants in three genes that are known to cause the disease. The genes are:

- Amyloid precursor protein (*APP*) on chromosome 21
- Presenilin 1 (*PSEN1*) on chromosome 14
- Presenilin 2 (*PSEN2*) on chromosome 1

When someone inherits an altered version of one of those genes, they will likely develop Alzheimer's before age 65 and sometimes much earlier.



People with Down syndrome are also at a higher risk for developing Alzheimer's before age 65 due to being born with an extra copy of chromosome 21, which carries the *APP* gene.

Genetic variants of the *APOE* gene are also known to influence the risk of Alzheimer's, but do not guarantee if a person will or will not develop the disease. *APOE* has several forms:

- *APOE* ϵ 2 may provide some protection against the disease. If Alzheimer's occurs in a person with this allele, it usually develops later in life than it would in someone with the *APOE* ϵ 4 gene. Roughly 5% to 10% of people have this allele.
- *APOE* ϵ 3, the most common allele, is believed to have a neutral effect on the disease — neither decreasing nor increasing risk of Alzheimer's.
- *APOE* ϵ 4 increases risk for Alzheimer's and is associated with an earlier age of disease onset in certain populations. About 15% to 25% of people have this allele, and 2% to 5% carry two copies.

Researchers are learning more about these and other genetic variants that may increase or decrease a person's risk. However, prevalence and risk associated with *APOE* and other genetic variants may not be the same across all population groups. More research is needed to better understand how certain genetic variants might affect a person's or group's risk for Alzheimer's and to identify treatment and prevention strategies that will work best for that particular group.

Is Genetic Testing an Option?

Genetic tests are not routinely used in doctor's offices to diagnose or predict the risk of developing Alzheimer's.

If a person has symptoms at an early age with a strong family history of Alzheimer's, a neurologist or other medical specialist may order a genetic test for *APP*, *PSEN1*, and *PSEN2*.

Although *APOE* testing is also available, the results can't fully predict who will or won't develop Alzheimer's. This type of testing is used primarily in research settings. Some people learn their *APOE* status through consumer genetic testing. These tests are available for a fee and provide some information about their results.

No matter how you obtain your genetic test results, you should talk with a genetic counselor or your doctor to better understand the results.



Joining an Alzheimer's Research Study

Joining a clinical trial or other research study is a way you can help scientists discover new information to improve the detection and treatment of Alzheimer's. People of all different races, ethnicities, ancestries, ages, and genders are needed for this research. Some studies need people with a family history or diagnosis of Alzheimer's while other studies need people with no history of the disease.

To find out more about clinical trials, talk with a doctor or visit the following websites:

Alzheimers.gov

Search for clinical trials and studies on brain health, cognitive decline, caregiving, and Alzheimer's and related dementias: www.alzheimers.gov/clinical-trials.

Find research centers across the United States, where you may find medical specialists in Alzheimer's: www.alzheimers.gov/taking-action/national-research-centers.

ClinicalTrials.gov

Search for actively recruiting studies and clinical trials: www.clinicaltrials.gov.

For More Information

NIA Alzheimer's and related Dementias Education and Referral (ADEAR) Center

800-438-4380

adear@nia.nih.gov

www.nia.nih.gov/alzheimers

The NIA ADEAR Center offers information and free print publications about Alzheimer's and related dementias for families, caregivers, and health professionals. ADEAR Center staff answer telephone, email, and written requests and make referrals to local and national resources.

MedlinePlus — National Library of Medicine

www.medlineplus.gov

National Human Genome Research Institute

www.genome.gov/health



National Institute on Aging

National Institutes of Health

NIH...Turning Discovery Into Health®

U.S. Department of Health and Human Services

NIH Publication No. 23-AG-8202 | May 2023