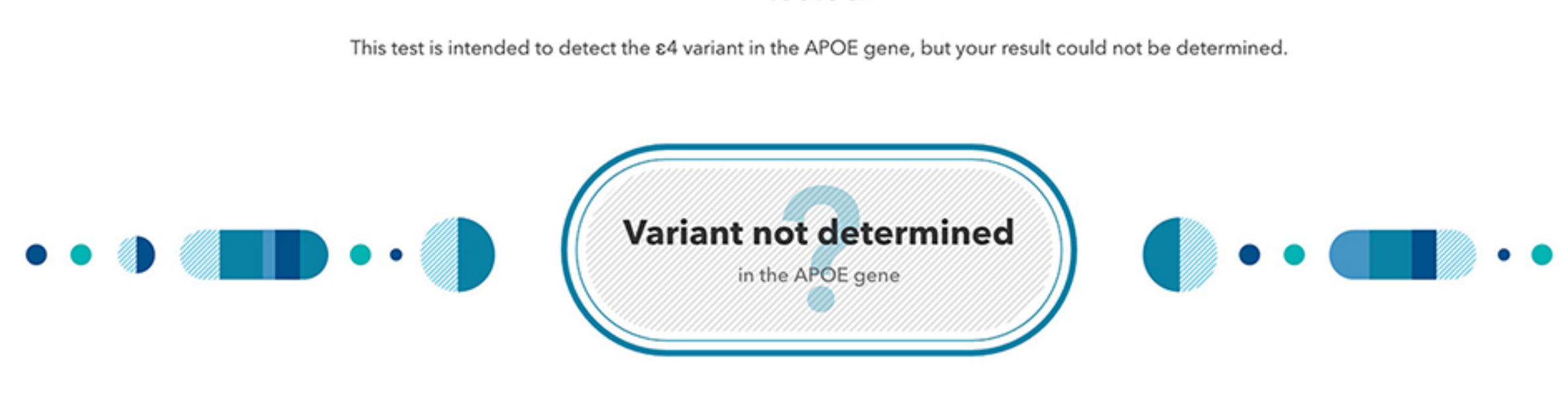
Late-Onset Alzheimer's Disease

Alzheimer's disease is characterized by memory loss, cognitive decline, and personality changes. Late-onset Alzheimer's disease is the most common form of Alzheimer's disease, developing after age 65. Many factors, including genetics, can influence a person's chances of developing the condition. This test includes the most common genetic variant associated with late-onset Alzheimer's disease.

Lois, we could **not determine** if you have the ε4 variant we tested.

This test is intended to detect the ε4 variant in the APOE gene, but your result could not be determined.



This can be caused by random test error or other factors that interfere with the test.

How To Use This Test

This test does not diagnose Alzheimer's disease or any other health conditions.

Please talk to a healthcare professional if this condition runs in your family, you think you might have this condition, or you have any concerns about your results.

Review the Genetic Health Risk tutorial
See Scientific Details
See Frequently Asked Questions

Intended Uses

- Tests for the **ε4 variant** in the APOE gene associated with an increased risk of developing late-onset Alzheimer's disease.

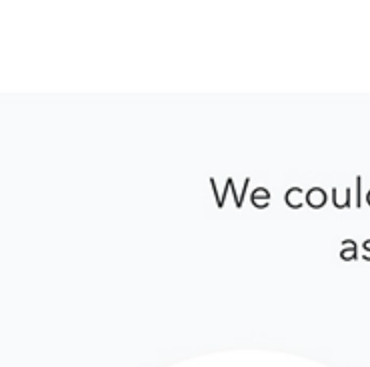
Limitations

- Does **not** include all possible variants or genes associated with late-onset Alzheimer's disease.
- Does **not** include any variants or genes linked to early-onset Alzheimer's disease.
- Does **not** determine a person's full APOE genotype.

Important Ethnicities

- The ε4 variant included in this test is found and has been studied in many ethnicities. Detailed risk estimates have been studied the most in people of **European** descent.

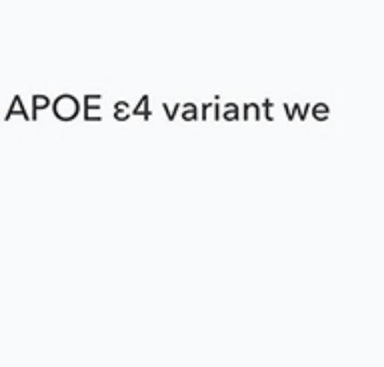
We could **not determine** if you have the ε4 variant we tested associated with late-onset Alzheimer's disease.



We could not rule out the APOE ε4 variant we tested.
See Scientific Details

There is still a chance of developing late-onset Alzheimer's disease.

Studies estimate that an average woman of **European** descent has a 3% chance of developing late-onset Alzheimer's disease by age 75 and a 14% chance by age 85. There is not enough data to estimate the chances in women of other ethnicities. Keep in mind that other factors also influence your risk.
See Scientific Details



Lifestyle and other factors can also influence the chances of developing late-onset Alzheimer's disease.

Consult with a healthcare professional before making any major lifestyle changes.

Age

The risk of developing Alzheimer's disease increases greatly as a person ages. This condition is most often diagnosed in people over the age of 65.

See Scientific Details for more information

Age
Sex
Family history
Heart health
Diet
Intellectual activity

About Late-Onset Alzheimer's Disease

When it develops

Late-onset Alzheimer's disease develops after 65 years of age.

Typical signs and symptoms

- Memory loss that worsens over time
- Mood and personality changes
- Trouble planning or solving problems
- Confusion with place or time
- Difficulty performing daily life activities

How common is the condition?

Late-onset Alzheimer's disease affects people of all ethnicities. One in nine Americans age 65 and older is affected by Alzheimer's disease. Elderly African Americans and Hispanics are more likely to develop the condition than people of other ethnicities.

How it's treated

There is currently no known prevention or cure for Alzheimer's disease. Medication may be used to delay or ease symptoms.

Read more at: Alzheimers.gov National Institute on Aging GeneReviews Genetics Home Reference

Learn more about late-onset Alzheimer's disease.

See our Frequently Asked Questions for more information.
FAQs

If you have a family history of this condition or think you have symptoms, consult with a healthcare professional.
Print report

Late-Onset Alzheimer's Disease

Scientific Details

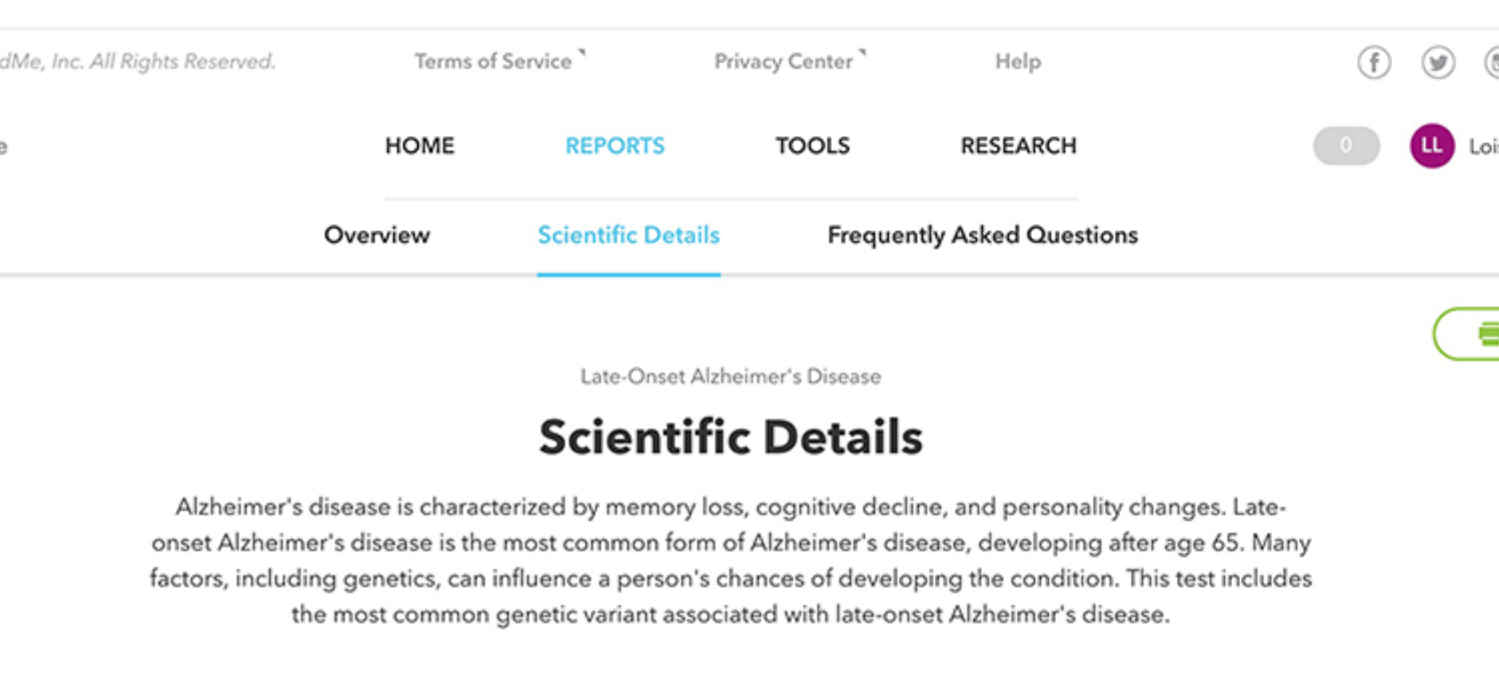
Alzheimer's disease is characterized by memory loss, cognitive decline, and personality changes. Late-onset Alzheimer's disease is the most common form of Alzheimer's disease, developing after age 65. Many factors, including genetics, can influence a person's chances of developing the condition. This test includes the most common genetic variant associated with late-onset Alzheimer's disease.

The ε4 variant in the APOE gene is the most common genetic factor associated with late-onset Alzheimer's disease.

APOE

The APOE gene contains instructions for making a protein called apolipoprotein E. This protein helps control the levels of cholesterol and fats in the blood. It is not known exactly how the ε4 variant increases the risk of late-onset Alzheimer's disease.

Read more at Genetics Home Reference



We could not determine if you have the ε4 variant we tested.

Variants Detected | View All Tested Markers

Marker Tested	Your Genotype*	Additional Information
ε4 Gene: APOE Marker: rs429358	**Not determined**	Biological explanation Typical vs. variant DNA sequence(s) Percent of 23andMe customers with variant References [1, 2, 4, 10, 12, 13, 14, 16, 17, 21] | ClinVar

*This test cannot distinguish which copy you received from which parent. This test also cannot determine whether multiple variants, if detected, were inherited from only one parent or from both parents. This may impact how these variants are passed down.

23andMe always reports genotypes based on the 'positive' strand of the human genome reference sequence (build 37). Other sources sometimes report genotypes using the opposite strand.

Test Interpretation

This report provides risk estimates for people of European, African American, East Asian, and South Asian descent. Estimates for other ethnicities are not currently available.

Health Risk Estimates

Risk estimates are based on clinical studies that identify an association between a genotype and a health condition.

Consider talking to a healthcare professional if you have any concerns about your results.

References [1, 9, 10, 17, 21]

Lifetime risk | Likelihood ratios | Odds ratios

The lifetime risk estimates shown below represent the proportion of people expected to develop Alzheimer's disease by age 65, 75, and 85. These values are based on people of European descent. Lifetime risk estimates are not available for people of other ethnicities.

Genetic result	Sex	Age 65	Age 75	Age 85
General population	Men	<1%	3%	11%
General population	Women	<1%	3%	14%
No ε4 variants	Men	<1%	1-2%	5-8%
No ε4 variants	Women	<1%	1-2%	6-10%
One copy of ε4 variant	Men	1%	4-7%	20-23%
One copy of ε4 variant	Women	<1%	5-7%	27-30%
Two copies of ε4 variant	Men	4%	28%	51%
Two copies of ε4 variant	Women	2%	28%	60%

Other Factors

Other factors besides the ε4 variant can influence your chances of developing late-onset Alzheimer's disease.

This is not a complete list of other factors.

People with multiple risk factors may have a higher risk of developing late-onset Alzheimer's disease.

Consult with a healthcare professional before making any major lifestyle changes.

Other Factors	References
Age Alzheimer's disease is most often diagnosed in people over the age of 65. About 1-4% of people have Alzheimer's disease at age 65. The risk increases dramatically every decade thereafter.	[4]
Sex More women than men have late-onset Alzheimer's disease. This may be partly due to the fact that women tend to live longer than men, but biological and lifestyle differences likely also play a role. Studies also suggest that the APOE ε4 variant is associated with a greater risk for late-onset Alzheimer's disease in women than in men.	[3, 4, 19]
Family history First-degree relatives of a person with late-onset Alzheimer's disease have a higher chance of developing late-onset Alzheimer's disease themselves. This may in part be explained by genetic factors, but it may also be related to family members sharing a similar lifestyle and environment.	[4, 8]
Heart health Many studies have investigated the relationship between cardiovascular risk factors and Alzheimer's disease. Evidence suggests that factors which increase the risk of cardiovascular disease (obesity, high cholesterol, and high blood pressure) also increase the risk of Alzheimer's disease in older age. Having type 2 diabetes has also been linked to increased risk of developing both cardiovascular disease and Alzheimer's disease.	[4, 15, 23, 24, 26]
Diet Understanding the effects of diet on Alzheimer's risk is an active area of research. Studies suggest a diet with plenty of green leafy vegetables, fruits, whole grains, and healthy fats such as those found in fish, nuts, and olive oil is associated with a reduced risk of developing Alzheimer's disease.	[4, 5, 20]
Intellectual activity Fewer years of education has been associated with a greater risk of developing Alzheimer's disease later in life. The risk appears to be highest in people who did not complete high school. The cause of this association is unclear. Some researchers hypothesize that more years of education may help people build stronger brain connections that can protect the brain against conditions like Alzheimer's disease. It could also be that lower education levels reflect lower socioeconomic status, which may limit a person's access to affordable health care and nutritious foods. All these factors as well as others may contribute to a higher risk of developing Alzheimer's disease.	[4, 5, 25, 26]
Exercise Understanding the effects of exercise on Alzheimer's risk is an active area of research. Evidence suggests that exercise benefits the brain and decreases the risk of developing Alzheimer's disease. This may result from many factors, including improvements in blood flow and lower risk of developing metabolic and cardiovascular diseases. In some studies, even a low-impact physical activity like walking was shown to be beneficial.	[4, 5, 7, 11]
Ethnicity African Americans and Hispanics develop late-onset Alzheimer's disease at higher rates than people of European and Asian descent. This may be due to differences in rates of other health conditions such as heart disease and diabetes, as well as differences in lifestyle and socioeconomic factors. The frequency of the APOE ε4 variant also differs between these groups.	[4, 18, 27, 28]
Other genes Many studies have identified additional genes and variants that influence risk for late-onset Alzheimer's disease. However, these variants have only a small effect on risk compared to the APOE ε4 variant.	[6, 22]

Test Details

Indications for Use

The 23andMe PGS Genetic Health Risk Report for Late-Onset Alzheimer's Disease is indicated for reporting of the ε4 variant in the APOE gene. This report describes if a person's genetic result is associated with an increased risk of developing late-onset Alzheimer's disease, but it does not describe a person's overall risk of developing Alzheimer's disease. The ε4 variant included in this report is found and has been studied in many ethnicities. Detailed risk estimates have been studied the most in people of European descent.

Special Considerations

- This test does not identify or report on the ε2 and ε3 variants of the APOE gene. These variants are not associated with an increased risk of developing Alzheimer's disease.
- Genetic testing for late-onset Alzheimer's disease is not currently recommended by any healthcare professional organizations.

Test Performance Summary

Clinical Performance [4]

- Approximately 40-65% of Alzheimer's patients have one or two copies of the APOE ε4 variant.
- However, many people with the APOE ε4 variant will not develop late-onset Alzheimer's disease.

Analytical Performance

Accuracy was determined by comparing results from this test with results from sequencing for 544 samples. 543 out of 544 genotype results were correct. While unlikely, this test may provide false positive or false negative results.

Warnings and Limitations

- This test does not cover all variants that could cause this condition.*
- This test does not diagnose any health conditions.
- Share results with your healthcare professional for any medical purposes.
- If you are concerned about your results, consult with a healthcare professional.

See the Package Insert for more details on use and performance of this test.

* Variants not included in this test may be very rare, may not be available on our genotyping platform, or may not pass our testing standards.

References

1. Agarwal R et al. (2014). "Association of apolipoprotein E genetic variation in Alzheimer's disease in Indian population: a meta-analysis." Am J Alzheimers Dis Other Demen. 29(7):575-82.
2. Alata W et al. (2015). "Human apolipoprotein E ε4 expression impairs cerebral vascularization and blood-brain barrier function in mice." J Cereb Blood Flow Metab. 35(1):86-94.
3. Altmann A et al. (2014). "Sex modifies the APOE-related risk of developing Alzheimer disease." Ann Neurol. 75(4):563-73.
4. Alzheimer's Association. (2016). "2016 Alzheimer's disease facts and figures." Alzheimers Dement. 12(4):459-509.
5. Baumgart M et al. (2015). "Summary of the evidence on modifiable risk factors for cognitive decline and dementia: A population-based perspective." Alzheimers Dement. 11(6):718-26.
6. Beecham GW et al. (2014). "Genome-wide association meta-analysis of neuropathologic features of Alzheimer's disease and related dementias." PLoS Genet. 10(9):e1004606.
7. Cass SP. (2017). "Alzheimer's Disease and Exercise: A Literature Review." Curr Sports Med Rep. 16(1):19-22.
8. Cupples LA et al. (2004). "Estimating risk curves for first-degree relatives of patients with Alzheimer's disease: the REVEAL study." Genet Med. 6(4):192-6.
9. Farrer LA et al. (1997). "Effects of age, sex, and ethnicity on the association between apolipoprotein E genotype and Alzheimer disease. A meta-analysis. APOE and Alzheimer Disease Meta Analysis Consortium." JAMA. 278(16):1349-56.
10. Genin E et al. (2011). "APOE and Alzheimer disease: a major gene with semi-dominant inheritance." Mol Psychiatry. 16(9):903-7.
11. Hamer M et al. (2009). "Physical activity and risk of neurodegenerative disease: a systematic review of prospective evidence." Psychol Med. 39(1):3-11.
12. Harris FM et al. (2003). "Carboxyl-terminal-truncated apolipoprotein E4 causes Alzheimer's disease-like neurodegeneration and behavioral deficits in transgenic mice." Proc Natl Acad Sci U S A. 100(19):10966-71.
13. Holtzman DM et al. (2012). "Apolipoprotein E and apolipoprotein E receptors: normal biology and roles in Alzheimer disease." Cold Spring Harb Perspect Med. 2(3):a006312.
14. Huang Y et al. (2014). "Apolipoprotein E: structure and function in lipid metabolism, neurobiology, and Alzheimer's diseases." Neurobiol Dis. 72 Pt A:3-12.
15. Iturria-Medina Y et al. (2016). "Early role of vascular dysregulation on late-onset Alzheimer's disease based on multifactorial data-driven analysis." Nat Commun. 7:11934.
16. Ji ZS et al. (2002). "Apolipoprotein E4 potentiates amyloid beta peptide-induced lysosomal leakage and apoptosis in neuronal cells." J Biol Chem. 277(24):21821-8.
17. Liu M et al. (2014). "Apolipoprotein E gene polymorphism and Alzheimer's disease in Chinese population: a meta-analysis." Sci Rep. 4:4383.
18. Mayeda ER et al. (2016). "Inequalities in dementia incidence between six racial and ethnic groups over 14 years." Alzheimers Dement. 12(3):216-24.
19. Mielke MM et al. (2014). "Clinical epidemiology of Alzheimer's disease: assessing sex and gender differences." Clin Epidemiol. 6:37-48.
20. Morris MC et al. (2015). "MIND diet associated with reduced incidence of Alzheimer's disease." Alzheimers Dement. 11(9):1007-14.
21. Murrell JR et al. (2006). "Association of apolipoprotein E genotype and Alzheimer disease in African Americans." Arch Neurol. 63(3):431-4.
22. Naj AC et al. (2014). "Effects of multiple genetic loci on age at onset in late-onset Alzheimer disease: a genome-wide association study." JAMA Neurol. 71(11):1394-404.
23. Reitz C et al. (2011). "Epidemiology of Alzheimer disease." Nat Rev Neurol. 7(3):137-52.
24. Rippon GA et al. (2006). "Familial Alzheimer disease in Latinos: interaction between APOE, stroke, and estrogen replacement." Neurology. 66(1):35-40.
25. Sando SB et al. (2008). "Risk-reducing effect of education in Alzheimer's disease." Int J Geriatr Psychiatry. 23(11):1156-62.
26. Satizabal CL et al. (2016). "Incidence of Dementia over Three Decades in the Framingham Heart Study." N Engl J Med. 374(6):523-32.
27. Tang MX et al. (1998). "The APOE-epsilon4 allele and the risk of Alzheimer disease among African Americans, whites, and Hispanics." JAMA. 279(10):751-5.
28. Tang MX et al. (2001). "Incidence of AD in African-Americans, Caribbean Hispanics, and Caucasians in northern Manhattan." Neurology. 56(1):49-56.
29. Wu P et al. (2015). "Associations between apolipoprotein E gene polymorphisms and Alzheimer's disease risk in a large Chinese Han population." Clin Interv Aging. 10:371-8.

Change Log

Your report may occasionally be updated based on new information. This Change Log describes updates and revisions to this report.

Date	Change
April 17, 2017	Late-onset Alzheimer's Disease report created.

Late-Onset Alzheimer's Disease

Frequently Asked Questions

Alzheimer's disease is characterized by memory loss, cognitive decline, and personality changes. Late-onset Alzheimer's disease is the most common form of Alzheimer's disease, developing after age 65. Many factors, including genetics, can influence a person's chances of developing the condition. This test includes the most common genetic variant associated with late-onset Alzheimer's disease.

Late-Onset Alzheimer's Disease

What does this test do?

This test looks for the ε4 variant in the APOE gene associated with late-onset Alzheimer's disease.

People with the ε4 variant are more likely to develop late-onset Alzheimer's disease. However, not everyone with this variant will develop the condition.

This test does not include all possible genetic variants or genes associated with late-onset Alzheimer's disease.

This test does not include any genetic variants or genes linked to early-onset Alzheimer's disease.

Is this answer helpful? Yes No

What does this test **not** do?

This test does not diagnose late-onset Alzheimer's disease. Only a healthcare professional can do that.

This test does not tell you if you have Alzheimer's disease or if you will definitely develop the condition in the future.

This test does not take into account other risk factors for late-onset Alzheimer's disease, such as personal and family health history. Thus, this test cannot provide a complete assessment of your risk of developing late-onset Alzheimer's disease.

This test does not include all possible genetic variants or genes associated with late-onset Alzheimer's disease.

This test does not include any genetic variants or genes linked to early-onset Alzheimer's disease.

Is this answer helpful? Yes No

The report says that detailed risk estimates for the ε4 variant included in this test are best studied in people of **European** descent. What if I'm not of European descent?

The effect of the ε4 variant on a person's lifetime risk of developing late-onset Alzheimer's disease is well understood in people of European descent. If a person who is not of European descent has the ε4 variant, he or she is still expected to have a higher risk for late-onset Alzheimer's disease, but the exact risk may vary depending on his or her ethnicity. See Scientific Details for more information about risk in people of non-European descent.

Is this answer helpful? Yes No

Where can I learn more about Alzheimer's disease, support groups, and other resources?

You can learn more about Alzheimer's disease from the following resources:

- Alzheimer's Association
- Alzheimer's Society
- AlzForum
- Alzheimer's Association Facts and Figures

If you have questions about your results or how they might affect you or your family, a genetic counselor may be able to help. Learn more about genetic counseling.

Is this answer helpful? Yes No

My report says my result **could not be determined.** What does this mean?

We could not tell if you do or do not have the ε4 variant. This can be caused by random test error or other factors that interfere with the test. Up to 2% of people may receive a "Not Determined" result for this report.

It is still possible to develop late-onset Alzheimer's disease. One in nine Americans age 65 and older is affected by Alzheimer's disease.

Other factors can also affect your risk of developing late-onset Alzheimer's disease, even if you do not have any genetic variants. Learn more about other factors.

Is this answer helpful? Yes No

My report says my result **could not be determined,** but I have a family history of Alzheimer's disease. What does this mean for me?

Many factors affect whether a person develops Alzheimer's disease. We could not determine whether you have the ε4 variant, so this variant may or may not be contributing to your family history. Other genetic or non-genetic factors may also influence your risk. It is important to discuss your family history of Alzheimer's disease with a healthcare professional in order to understand the different contributing factors. Learn more about other factors.

Is this answer helpful? Yes No

My report says my result **could not be determined.** What are some things I could do?

Because we could not determine your result, it is still possible to have the ε4 genetic variant. Other non-genetic factors can also affect your risk for Alzheimer's disease. Learn more about other factors.

Consider talking to a healthcare professional if:

- Alzheimer's disease runs in your family.
- You think you might have symptoms of Alzheimer's disease.
- You have questions about other risk factors you may have.

Is this answer helpful? Yes No

Have more questions? Check out our Customer Care Help Center.