



Prion disease

Prion disease represents a group of conditions that affect the nervous system in humans and animals. In people, these conditions impair brain function, causing changes in memory, personality, and behavior; a decline in intellectual function (dementia); and abnormal movements, particularly difficulty with coordinating movements (ataxia). The signs and symptoms of prion disease typically begin in adulthood and worsen with time, leading to death within a few months to several years.

Frequency

These disorders are very rare. Although the exact prevalence of prion disease is unknown, studies suggest that this group of conditions affects about one person per million worldwide each year. Approximately 350 new cases are reported annually in the United States.

Causes

Between 10 and 15 percent of all cases of prion disease are caused by mutations in the *PRNP* gene. Because they can run in families, these forms of prion disease are classified as familial. Familial prion diseases, which have overlapping signs and symptoms, include familial Creutzfeldt-Jakob disease (CJD), Gerstmann-Sträussler-Scheinker syndrome (GSS), and fatal familial insomnia (FFI).

The *PRNP* gene provides instructions for making a protein called prion protein (PrP). Although the precise function of this protein is unknown, researchers have proposed roles in several important processes. These include the transport of copper into cells, protection of brain cells (neurons) from injury (neuroprotection), and communication between neurons. In familial forms of prion disease, *PRNP* gene mutations result in the production of an abnormally shaped protein, known as PrP^{Sc}, from one copy of the gene. In a process that is not fully understood, PrP^{Sc} can attach (bind) to the normal protein (PrP^C) and promote its transformation into PrP^{Sc}. The abnormal protein builds up in the brain, forming clumps that damage or destroy neurons. The loss of these cells creates microscopic sponge-like holes (vacuoles) in the brain, which leads to the signs and symptoms of prion disease.

The other 85 to 90 percent of cases of prion disease are classified as either sporadic or acquired. People with sporadic prion disease have no family history of the disease and no identified mutation in the *PRNP* gene. Sporadic disease occurs when PrP^C spontaneously, and for unknown reasons, is transformed into PrP^{Sc}. Sporadic forms of prion disease include sporadic Creutzfeldt-Jakob disease (sCJD), sporadic fatal insomnia (sFI), and variably protease-sensitive prionopathy (VPSPr).

Acquired prion disease results from exposure to PrP^{Sc} from an outside source. For example, variant Creutzfeldt-Jakob disease (vCJD) is a type of acquired prion disease in humans that results from eating beef products containing PrP^{Sc} from cattle with prion disease. In cows, this form of the disease is known as bovine spongiform encephalopathy (BSE) or, more commonly, "mad cow disease." Another example of an acquired human prion disease is kuru, which was identified in the South Fore population in Papua New Guinea. The disorder was transmitted when individuals ate affected human tissue during cannibalistic funeral rituals.

Rarely, prion disease can be transmitted by accidental exposure to PrP^{Sc}-contaminated tissues during a medical procedure. This type of prion disease, which accounts for 1 to 2 percent of all cases, is classified as iatrogenic.

Inheritance Pattern

Familial forms of prion disease are inherited in an autosomal dominant pattern, which means one copy of the altered *PRNP* gene in each cell is sufficient to cause the disorder. In most cases, an affected person inherits the altered gene from one affected parent. In some people, familial forms of prion disease are caused by a new mutation in the gene that occurs during the formation of a parent's reproductive cells (eggs or sperm) or in early embryonic development. Although such people do not have an affected parent, they can pass the genetic change to their children.

The sporadic, acquired, and iatrogenic forms of prion disease, including kuru and variant Creutzfeldt-Jakob disease, are not inherited.

Other Names for This Condition

- inherited human transmissible spongiform encephalopathies
- prion-associated disorders
- prion-induced disorders
- prion protein diseases
- transmissible dementias
- transmissible spongiform encephalopathies
- TSEs

Diagnosis & Management

Genetic Testing Information

- What is genetic testing?
[/primer/testing/genetictesting](#)
- Genetic Testing Registry: Fatal familial insomnia
<https://www.ncbi.nlm.nih.gov/gtr/conditions/C0206042/>

- Genetic Testing Registry: Genetic prion diseases
<https://www.ncbi.nlm.nih.gov/gtr/conditions/C0162534/>
- Genetic Testing Registry: Gerstmann-Straussler-Scheinker syndrome
<https://www.ncbi.nlm.nih.gov/gtr/conditions/C0017495/>
- Genetic Testing Registry: Jakob-Creutzfeldt disease
<https://www.ncbi.nlm.nih.gov/gtr/conditions/C0022336/>
- Genetic Testing Registry: Kuru, susceptibility to
<https://www.ncbi.nlm.nih.gov/gtr/conditions/C1855588/>

Research Studies from ClinicalTrials.gov

- ClinicalTrials.gov
<https://clinicaltrials.gov/ct2/results?cond=%22prion+disease%22+OR+%22Creutzfeldt-Jakob+disease%22+OR+%22Gerstmann-Straussler-Scheinker+syndrome%22+OR+%22fatal+familial+insomnia%22>

Other Diagnosis and Management Resources

- Creutzfeldt-Jakob Disease Foundation: Caregiving Ideas
<https://cjd.foundation.org/caregiving>
- GeneReview: Genetic Prion Diseases
<https://www.ncbi.nlm.nih.gov/books/NBK1229>
- MedlinePlus Encyclopedia: Creutzfeldt-Jakob disease
<https://medlineplus.gov/ency/article/000788.htm>
- MedlinePlus Encyclopedia: Kuru
<https://medlineplus.gov/ency/article/001379.htm>

Additional Information & Resources

Health Information from MedlinePlus

- Encyclopedia: Creutzfeldt-Jakob disease
<https://medlineplus.gov/ency/article/000788.htm>
- Encyclopedia: Kuru
<https://medlineplus.gov/ency/article/001379.htm>
- Health Topic: Creutzfeldt-Jakob Disease
<https://medlineplus.gov/creutzfeldtjakobdisease.html>
- Health Topic: Degenerative Nerve Diseases
<https://medlineplus.gov/degenerativenervediseases.html>
- Health Topic: Genetic Brain Disorders
<https://medlineplus.gov/geneticbraindisorders.html>

Genetic and Rare Diseases Information Center

- Creutzfeldt-Jakob disease
<https://rarediseases.info.nih.gov/diseases/6956/creutzfeldt-jakob-disease>
- Gerstmann-Straussler-Scheinker disease
<https://rarediseases.info.nih.gov/diseases/7690/gerstmann-straussler-scheinker-disease>
- Variant Creutzfeldt-Jakob disease
<https://rarediseases.info.nih.gov/diseases/9550/variant-creutzfeldt-jakob-disease>

Additional NIH Resources

- National Institute of Allergy and Infectious Diseases: Prion Diseases
<https://www.niaid.nih.gov/diseases-conditions/prion-diseases>
- National Institute of Neurological Disorders and Stroke: Creutzfeldt-Jakob Disease Fact Sheet
<https://www.ninds.nih.gov/Disorders/All-Disorders/Creutzfeldt-Jakob-Disease-Information-Page>
- National Institute of Neurological Disorders and Stroke: Gerstmann-Straussler-Scheinker Disease Information Page
<https://www.ninds.nih.gov/Disorders/All-Disorders/Gerstmann-Straussler-Scheinker-Disease-Information-Page>
- National Institute of Neurological Disorders and Stroke: Kuru Information Page
<https://www.ninds.nih.gov/Disorders/All-Disorders/Kuru-Information-Page>
- National Institute of Neurological Disorders and Stroke: Transmissible Spongiform Encephalopathies Information Page
<https://www.ninds.nih.gov/Disorders/All-Disorders/Transmissible-Spongiform-Encephalopathies-Information-Page>

Educational Resources

- Centers for Disease Control and Prevention: About Prion Diseases
<https://www.cdc.gov/prions/>
- Johns Hopkins Medicine: Prion Diseases
<https://www.hopkinsmedicine.org/health/conditions-and-diseases/prion-diseases>
- MalaCards: prion disease
https://www.malacards.org/card/prion_disease
- Merck Manual Home Edition for Patients and Caregivers
<https://www.merckmanuals.com/home/brain-spinal-cord-and-nerve-disorders/prion-diseases/overview-of-prion-diseases>
- Orphanet: Fatal familial insomnia
https://www.orpha.net/consor/cgi-bin/OC_Exp.php?Lng=EN&Expert=466

- Orphanet: Gerstmann-Straussler-Scheinker syndrome
https://www.orpha.net/consor/cgi-bin/OC_Exp.php?Lng=EN&Expert=356
- Orphanet: Human prion disease
https://www.orpha.net/consor/cgi-bin/OC_Exp.php?Lng=EN&Expert=56970
- Orphanet: Sporadic Creutzfeldt-Jakob disease
https://www.orpha.net/consor/cgi-bin/OC_Exp.php?Lng=EN&Expert=204
- University of California, San Francisco Memory and Aging Center
<https://memory.ucsf.edu/dementia/rapidly-progressive-dementias/prion-diseases>
- World Health Organization: Prion Diseases
https://www.who.int/zoonoses/diseases/prion_diseases/en/

Patient Support and Advocacy Resources

- Alzheimer's Association: Creutzfeldt-Jakob Disease
<https://www.alz.org/alzheimers-dementia/what-is-dementia/types-of-dementia/creutzfeldt-jakob-disease>
- Contact a Family (UK): Creutzfeldt-Jakob Disease
<https://contact.org.uk/medical-information/conditions/c/creutzfeldt-jakob-disease/>
- Creutzfeldt-Jakob Disease Foundation
<https://cjd.foundation.org/>
- National Organization for Rare Disorders (NORD): Creutzfeldt-Jakob Disease
<https://rarediseases.org/rare-diseases/creutzfeldt-jakob-disease/>
- National Prion Disease Pathology Surveillance Center
<https://case.edu/medicine/pathology/divisions/prion-center/>
- The UK Creutzfeldt-Jakob Disease Surveillance Unit
<http://www.cjd.ed.ac.uk/>

Clinical Information from GeneReviews

- Genetic Prion Diseases
<https://www.ncbi.nlm.nih.gov/books/NBK1229>

Scientific Articles on PubMed

- PubMed
<https://www.ncbi.nlm.nih.gov/pubmed?term=%28Prion+Diseases%5BMAJR%5D%29+AND+%28%28prion+disease%5BTIAB%5D%29+OR+%28Creutzfeldt-Jakob+disease%5BTIAB%5D%29+OR+%28fatal+familial+insomnia%5BTIAB%5D%29+OR+%28Gerstmann-Straussler-Scheinker+syndrome%5BTIAB%5D%29%29+AND+english%5Bla%5D+AND+human%5Bmh%5D+AND+%22last+360+days%22%5Bdp%5D>

Catalog of Genes and Diseases from OMIM

- CREUTZFELDT-JAKOB DISEASE
<http://omim.org/entry/123400>
- FATAL FAMILIAL INSOMNIA
<http://omim.org/entry/600072>
- GERSTMANN-STRAUSSLER DISEASE
<http://omim.org/entry/137440>
- KURU, SUSCEPTIBILITY TO
<http://omim.org/entry/245300>

Sources for This Summary

- Aguzzi A, Heikenwalder M. Pathogenesis of prion diseases: current status and future outlook. *Nat Rev Microbiol.* 2006 Oct;4(10):765-75. Review.
Citation on PubMed: <https://www.ncbi.nlm.nih.gov/pubmed/16980938>
- Aguzzi A. Prion diseases of humans and farm animals: epidemiology, genetics, and pathogenesis. *J Neurochem.* 2006 Jun;97(6):1726-39. Review.
Citation on PubMed: <https://www.ncbi.nlm.nih.gov/pubmed/16805779>
- Brown K, Mastrianni JA. The prion diseases. *J Geriatr Psychiatry Neurol.* 2010 Dec;23(4):277-98. doi: 10.1177/0891988710383576. Epub 2010 Oct 11. Review.
Citation on PubMed: <https://www.ncbi.nlm.nih.gov/pubmed/20938044>
- Capellari S, Strammiello R, Saverioni D, Kretschmar H, Parchi P. Genetic Creutzfeldt-Jakob disease and fatal familial insomnia: insights into phenotypic variability and disease pathogenesis. *Acta Neuropathol.* 2011 Jan;121(1):21-37. doi: 10.1007/s00401-010-0760-4. Epub 2010 Oct 27. Review.
Citation on PubMed: <https://www.ncbi.nlm.nih.gov/pubmed/20978903>
- Glatzel M, Stoeck K, Seeger H, Lührs T, Aguzzi A. Human prion diseases: molecular and clinical aspects. *Arch Neurol.* 2005 Apr;62(4):545-52. Review.
Citation on PubMed: <https://www.ncbi.nlm.nih.gov/pubmed/15824251>
- Head MW, Ironside JW. Review: Creutzfeldt-Jakob disease: prion protein type, disease phenotype and agent strain. *Neuropathol Appl Neurobiol.* 2012 Jun;38(4):296-310. doi: 10.1111/j.1365-2990.2012.01265.x. Review.
Citation on PubMed: <https://www.ncbi.nlm.nih.gov/pubmed/22394291>
- Imran M, Mahmood S. An overview of human prion diseases. *Virology.* 2011 Dec 24;8:559. doi: 10.1186/1743-422X-8-559. Review.
Citation on PubMed: <https://www.ncbi.nlm.nih.gov/pubmed/22196171>
Free article on PubMed Central: <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3296552/>
- Johnson RT. Prion diseases. *Lancet Neurol.* 2005 Oct;4(10):635-42. Review.
Citation on PubMed: <https://www.ncbi.nlm.nih.gov/pubmed/16168932>
- Mastrianni JA. Genetic Prion Diseases. 2003 Mar 27 [updated 2014 Jan 2]. In: Pagon RA, Adam MP, Ardinger HH, Wallace SE, Amemiya A, Bean LJH, Bird TD, Ledbetter N, Mefford HC, Smith RJH, Stephens K, editors. *GeneReviews®* [Internet]. Seattle (WA): University of Washington, Seattle; 1993-2017. Available from <http://www.ncbi.nlm.nih.gov/books/NBK1229/>
Citation on PubMed: <https://www.ncbi.nlm.nih.gov/pubmed/20301407>

- Montagna P, Gambetti P, Cortelli P, Lugaresi E. Familial and sporadic fatal insomnia. *Lancet Neurol.* 2003 Mar;2(3):167-76. Review.
Citation on PubMed: <https://www.ncbi.nlm.nih.gov/pubmed/12849238>
 - Prusiner SB. Shattuck lecture--neurodegenerative diseases and prions. *N Engl J Med.* 2001 May 17;344(20):1516-26. Review.
Citation on PubMed: <https://www.ncbi.nlm.nih.gov/pubmed/11357156>
 - Puoti G, Bizzi A, Forloni G, Safar JG, Tagliavini F, Gambetti P. Sporadic human prion diseases: molecular insights and diagnosis. *Lancet Neurol.* 2012 Jul;11(7):618-28. doi: 10.1016/S1474-4422(12)70063-7. Review. Erratum in: *Lancet Neurol.* 2012 Oct;11(10):841.
Citation on PubMed: <https://www.ncbi.nlm.nih.gov/pubmed/22710755>
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Reprinted from Genetics Home Reference:
<https://ghr.nlm.nih.gov/condition/prion-disease>

Reviewed: January 2014
Published: June 11, 2019

Lister Hill National Center for Biomedical Communications
U.S. National Library of Medicine
National Institutes of Health
Department of Health & Human Services