CEP290 gene

centrosomal protein 290

Normal Function

The *CEP290* gene provides instructions for making a protein that is present in many types of cells. Although this protein's function is not well understood, studies suggest that it plays an important role in cell structures called centrosomes and cilia. Centrosomes are involved in cell division and the assembly of microtubules, which are proteins that transport materials in cells and help the cell maintain its shape. Cilia are microscopic, finger-like projections that stick out from the surface of cells. Cilia are involved in cell movement and many different chemical signaling pathways. They are also necessary for the perception of sensory input (such as vision, hearing, and smell).

Health Conditions Related to Genetic Changes

Leber congenital amaurosis

At least 35 mutations in the *CEP290* gene have been found to cause Leber congenital amaurosis. Mutations in this gene account for 15 to 22 percent of all cases of this condition.

A particular genetic change, written as 2991+1655A>G, is the most common *CEP290* gene mutation associated with Leber congenital amaurosis. This mutation reduces the production of functional CEP290 protein to very low levels in cells. Other genetic changes responsible for this disorder result in the production of abnormally short, nonfunctional versions of the CEP290 protein.

It is unclear how mutations in the *CEP290* gene cause the characteristic features of Leber congenital amaurosis. A shortage of the CEP290 protein clearly affects the development of the retina, which is the specialized tissue at the back of the eye that detects light and color. Light-sensing cells (photoreceptors) in the retina contain cilia, which are essential for normal vision. Abnormalities involving these cilia may lead to the severe, early visual impairment characteristic of Leber congenital amaurosis.

Bardet-Biedl syndrome

Joubert syndrome

Meckel syndrome

Senior-Løken syndrome

Other disorders

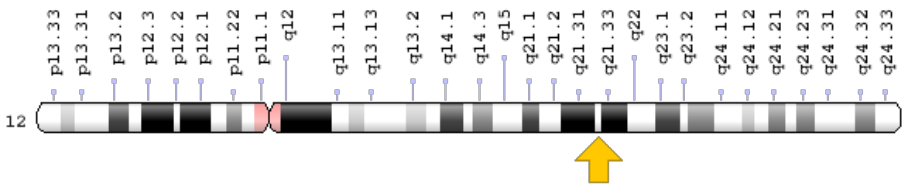
Several dozen mutations in the *CEP290* gene have been identified in other syndromes associated with abnormal cilia. These conditions, which are known as ciliopathies, include Joubert syndrome, Meckel syndrome, Senior-Løken syndrome, and Bardet-Biedl syndrome. The features of these disorders overlap significantly. They each affect multiple organ systems, most commonly the brain and spinal cord (central nervous system), retina, and kidneys. Meckel syndrome is typically the most severe of the *CEP290*-associated ciliopathies; affected individuals usually die before or shortly after birth.

The *CEP290* gene mutations responsible for these disorders lead to the production of an abnormally short version of the CEP290 protein. The abnormal protein likely disrupts cilia function in many different parts of the body. However, it is unclear how mutations in this single gene can cause multiple disorders. Researchers speculate that changes in other genes, particularly genes involved in cilia function, may contribute to the varied signs and symptoms of these conditions.

Chromosomal Location

Cytogenetic Location: 12q21.32, which is the long (q) arm of chromosome 12 at position 21.32

Molecular Location: base pairs 88,049,013 to 88,142,216 on chromosome 12 (Homo sapiens Updated Annotation Release 109.20200522, GRCh38.p13) (NCBI)



Credit: Genome Decoration Page/NCBI

Other Names for This Gene

- 3H11Ag
- BBS14
- cancer/testis antigen 87
- CE290_HUMAN
- centrosomal protein 290kDa
- centrosomal protein of 290 kDa
- CT87

- CTCL tumor antigen se2-2
- FLJ13615
- FLJ21979
- JBTS5
- JBTS6
- KIAA0373
- LCA10
- MKS4
- monoclonal antibody 3H11 antigen
- nephrocytsin-6
- NPHP6
- POC3
- POC3 centriolar protein homolog
- prostate cancer antigen T21
- rd16
- SLSN6
- tumor antigen se2-2

Additional Information & Resources

Educational Resources

- Molecular Cell Biology (first edition, 2000): Cilia and Flagella: Structure and Movement
  https://www.ncbi.nlm.nih.gov/books/NBK21698/

Clinical Information from GeneReviews

- Bardet-Biedl Syndrome Overview
  https://www.ncbi.nlm.nih.gov/books/NBK1363
- Joubert Syndrome
  https://www.ncbi.nlm.nih.gov/books/NBK1325
- Leber Congenital Amaurosis / Early-Onset Severe Retinal Dystrophy Overview
  https://www.ncbi.nlm.nih.gov/books/NBK531510

Scientific Articles on PubMed

- PubMed
  https://www.ncbi.nlm.nih.gov/pubmed?term=%28%28CEP290%5BTIAB%5D%29+OR+%28NPHP6%5BTIAB%5D%29%29+AND+%28%28Genes%5BMH%5D%29+OR+%28Genetic+Phenomena%5BMH%5D%29%29+AND+english%5Bla%5D+AND+human%5Bmh%5D+AND+%22last+1800+days%22%5Bdp%5D

Catalog of Genes and Diseases from OMIM

- CENTROSOMAL PROTEIN, 290-KD
  http://omim.org/entry/610142
- JOUBERT SYNDROME 5
  http://omim.org/entry/610188
- MECKEL SYNDROME, TYPE 4
  http://omim.org/entry/611134
- SENIOR-LOKEN SYNDROME 6
  http://omim.org/entry/610189

Research Resources

- ClinVar
  https://www.ncbi.nlm.nih.gov/clinvar?term=CEP290%5Bgene%5D
- HGNC Gene Symbol Report
  https://www.genenames.org/data/gene-symbol-report/#!/hgnc_id/HGNC:29021
- Monarch Initiative
  https://monarchinitiative.org/gene/NCBIGene:80184
- NCBI Gene
  https://www.ncbi.nlm.nih.gov/gene/80184
- UniProt
  https://www.uniprot.org/uniprot/O15078

Sources for This Summary

- Baala L, Audollent S, Martinovic J, Ozilou C, Babron MC, Sivanandamoorthy S, Saunier S, Salomon R, Gonzales M, Rattenberry E, Esculpavit C, Toutain A, Moraine C, Parent P, Marcorelles P, Dauge MC, Roume J, Le Merrer M, Meiner V, Meir K, Menez F, Beaufrère AM, Francannet C, Tantau J, Sinico M, Dumez Y, MacDonald F, Munnich A, Lyonnet S, Gubler MC, Génin E, Johnson CA, Vekemans M, Encha-Razavi F, Attié-Bitach T. Pleiotropic effects of CEP290 (NPHP6) mutations extend to Meckel syndrome. Am J Hum Genet. 2007 Jul;81(1):170-9. Epub 2007 Jun 4.
  Citation on PubMed: https://www.ncbi.nlm.nih.gov/pubmed/17564974
  Free article on PubMed Central: https://www.ncbi.nlm.nih.gov/pmc/articles/PMC1950929/
- Brancati F, Barrano G, Silhavy JL, Marsh SE, Travaglini L, Bielas SL, Amorini M, Zablocka D, Kayserili H, Al-Gazali L, Bertini E, Boltshauser E, D'Hooghe M, Fazzi E, Fenerci EY, Hennekam RC, Kiss A, Lees MM, Marco E, Phadke SR, Rigoli L, Romano S, Salpietro CD, Sherr EH, Signorini S, Stromme P, Stuart B, Sztriha L, Viskochil DH, Yuksel A, Dallapiccola B; International JSRD Study Group, Valente EM, Gleeson JG. CEP290 mutations are frequently identified in the oculo-renal form of Joubert syndrome-related disorders. Am J Hum Genet. 2007 Jul;81(1):104-13. Epub 2007 May 18.
  Citation on PubMed: https://www.ncbi.nlm.nih.gov/pubmed/17564967
  Free article on PubMed Central: https://www.ncbi.nlm.nih.gov/pmc/articles/PMC1950920/
- Frank V, den Hollander AI, Brüchle NO, Zonneveld MN, Nürnberg G, Becker C, Du Bois G, Kendziorra H, Roosing S, Senderek J, Nürnberg P, Cremers FP, Zerres K, Bergmann C. Mutations of the CEP290 gene encoding a centrosomal protein cause Meckel-Gruber syndrome. Hum Mutat. 2008 Jan;29(1):45-52.
  Citation on PubMed: https://www.ncbi.nlm.nih.gov/pubmed/17705300
- Helou J, Otto EA, Attanasio M, Allen SJ, Parisi MA, Glass I, Utsch B, Hashmi S, Fazzi E, Omran H, O'Toole JF, Sayer JA, Hildebrandt F. Mutation analysis of NPHP6/CEP290 in patients with Joubert syndrome and Senior-Løken syndrome. J Med Genet. 2007 Oct;44(10):657-63. Epub 2007 Jul 6.
  Citation on PubMed: https://www.ncbi.nlm.nih.gov/pubmed/17617513
  Free article on PubMed Central: https://www.ncbi.nlm.nih.gov/pmc/articles/PMC2597962/
- Leitch CC, Zaghloul NA, Davis EE, Stoetzel C, Diaz-Font A, Rix S, Alfadhel M, Lewis RA, Eyaid W, Banin E, Dollfus H, Beales PL, Badano JL, Katsanis N. Hypomorphic mutations in syndromic encephalocele genes are associated with Bardet-Biedl syndrome. Nat Genet. 2008 Apr;40(4):443-8. doi: 10.1038/ng.97. Epub 2008 Mar 9. Erratum in: Nat Genet. 2008 Jul;40(7):927. Al-Fadhel, Majid [corrected to Alfadhel, Majid].
  Citation on PubMed: https://www.ncbi.nlm.nih.gov/pubmed/18327255
- Moradi P, Davies WL, Mackay DS, Cheetham ME, Moore AT. Focus on molecules: centrosomal protein 290 (CEP290). Exp Eye Res. 2011 May;92(5):316-7. doi: 10.1016/j.exer.2010.05.009. Epub 2010 May 20.
  Citation on PubMed: https://www.ncbi.nlm.nih.gov/pubmed/20493186
- Perrault I, Delphin N, Hanein S, Gerber S, Dufier JL, Roche O, Defoort-Dhellemmes S, Dollfus H, Fazzi E, Munnich A, Kaplan J, Rozet JM. Spectrum of NPHP6/CEP290 mutations in Leber congenital amaurosis and delineation of the associated phenotype. Hum Mutat. 2007 Apr;28(4):416.
  Citation on PubMed: https://www.ncbi.nlm.nih.gov/pubmed/17345604

- Sayer JA, Otto EA, O'Toole JF, Nurnberg G, Kennedy MA, Becker C, Hennies HC, Helou J, Attanasio M, Fausett BV, Utsch B, Khanna H, Liu Y, Drummond I, Kawakami I, Kusakabe T, Tsuda M, Ma L, Lee H, Larson RG, Allen SJ, Wilkinson CJ, Nigg EA, Shou C, Lillo C, Williams DS, Hoppe B, Kemper MJ, Neuhaus T, Parisi MA, Glass IA, Petry M, Kispert A, Gloy J, Ganner A, Walz G, Zhu X, Goldman D, Nurnberg P, Swaroop A, Leroux MR, Hildebrandt F. The centrosomal protein nephrocystin-6 is mutated in Joubert syndrome and activates transcription factor ATF4. Nat Genet. 2006 Jun;38(6):674-81. Epub 2006 May 7.
  Citation on PubMed: https://www.ncbi.nlm.nih.gov/pubmed/16682973
- Travaglini L, Brancati F, Attie-Bitach T, Audollent S, Bertini E, Kaplan J, Perrault I, Iannicelli M, Mancuso B, Rigoli L, Rozet JM, Swistun D, Tolentino J, Dallapiccola B, Gleeson JG, Valente EM; International JSRD Study Group, Zankl A, Leventer R, Grattan-Smith P, Janecke A, D'Hooghe M, Sznajer Y, Van Coster R, Demerleir L, Dias K, Moco C, Moreira A, Kim CA, Maegawa G, Petkovic D, Abdel-Salam GM, Abdel-Aleem A, Zaki MS, Marti I, Quijano-Roy S, Sigaudy S, de Lonlay P, Romano S, Touraine R, Koenig M, Lagier-Tourenne C, Messer J, Collignon P, Wolf N, Philippi H, Kitsiou Tzeli S, Halldorsson S, Johannsdottir J, Ludvigsson P, Phadke SR, Udani V, Stuart B, Magee A, Lev D, Michelson M, Ben-Zeev B, Fischetto R, Benedicenti F, Stanzial F, Borgatti R, Accorsi P, Battaglia S, Fazzi E, Giordano L, Pinelli L, Boccone L, Bigoni S, Ferlini A, Donati MA, Caridi G, Divizia MT, Faravelli F, Ghiggeri G, Pessagno A, Briguglio M, Briuglia S, Salpietro CD, Tortorella G, Adami A, Castorina P, Lalatta F, Marra G, Riva D, Scelsa B, Spaccini L, Uziel G, Del Giudice E, Laverda AM, Ludwig K, Permunian A, Suppiej A, Signorini S, Uggetti C, Battini R, Di Giacomo M, Cilio MR, Di Sabato ML, Leuzzi V, Parisi P, Pollazzon M, Silengo M, De Vescovi R, Greco D, Romano C, Cazzagon M, Simonati A, Al-Tawari AA, Bastaki L, Mégarbané A, Sabolic Avramovska V, de Jong MM, Stromme P, Koul R, Rajab A, Azam M, Barbot C, Martorell Sampol L, Rodriguez B, Pascual-Castroviejo I, Teber S, Anlar B, Comu S, Karaca E, Kayserili H, Yüksel A, Akcakus M, Al Gazali L, Sztriha L, Nicholl D, Woods CG, Bennett C, Hurst J, Sheridan E, Barnicoat A, Hennekam R, Lees M, Blair E, Bernes S, Sanchez H, Clark AE, DeMarco E, Donahue C, Sherr E, Hahn J, Sanger TD, Gallager TE, Dobyns WB, Daugherty C, Krishnamoorthy KS, Sarco D, Walsh CA, McKanna T, Milisa J, Chung WK, De Vivo DC, Raynes H, Schubert R, Seward A, Brooks DG, Goldstein A, Caldwell J, Finsecke E, Maria BL, Holden K, Cruse RP, Swoboda KJ, Viskochil D. Expanding CEP290 mutational spectrum in ciliopathies. Am J Med Genet A. 2009 Oct;149A(10): 2173-80. doi: 10.1002/ajmg.a.33025.
  Citation on PubMed: https://www.ncbi.nlm.nih.gov/pubmed/19764032
  Free article on PubMed Central: https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4340070/
- Valente EM, Silhavy JL, Brancati F, Barrano G, Krishnaswami SR, Castori M, Lancaster MA, Boltshauser E, Boccone L, Al-Gazali L, Fazzi E, Signorini S, Louie CM, Bellacchio E; International Joubert Syndrome Related Disorders Study Group, Bertini E, Dallapiccola B, Gleeson JG. Mutations in CEP290, which encodes a centrosomal protein, cause pleiotropic forms of Joubert syndrome. Nat Genet. 2006 Jun;38(6):623-5. Epub 2006 May 7.
  Citation on PubMed: https://www.ncbi.nlm.nih.gov/pubmed/16682970
- den Hollander AI, Koenekoop RK, Yzer S, Lopez I, Arends ML, Voesenek KE, Zonneveld MN, Strom TM, Meitinger T, Brunner HG, Hoyng CB, van den Born LI, Rohrschneider K, Cremers FP. Mutations in the CEP290 (NPHP6) gene are a frequent cause of Leber congenital amaurosis. Am J Hum Genet. 2006 Sep;79(3):556-61. Epub 2006 Jul 11.
  Citation on PubMed: https://www.ncbi.nlm.nih.gov/pubmed/16909394
  Free article on PubMed Central: https://www.ncbi.nlm.nih.gov/pmc/articles/PMC1559533/

Reviewed: August 2010
Published: August 17, 2020

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