

RB1 gene

RB transcriptional corepressor 1

Normal Function

The *RB1* gene provides instructions for making a protein called pRB. This protein acts as a tumor suppressor, which means that it regulates cell growth and keeps cells from dividing too fast or in an uncontrolled way. Under certain conditions, pRB stops other proteins from triggering DNA replication, the process by which DNA makes a copy of itself. Because DNA replication must occur before a cell can divide, tight regulation of this process controls cell division and helps prevent the growth of tumors. Additionally, pRB interacts with other proteins to influence cell survival, the self-destruction of cells (apoptosis), and the process by which cells mature to carry out special functions (differentiation).

Health Conditions Related to Genetic Changes

Retinoblastoma

Hundreds of mutations in the *RB1* gene have been identified in people with retinoblastoma, a rare type of eye cancer that typically affects young children. This cancer develops in the retina, which is the specialized light-sensitive tissue at the back of the eye that detects light and color. Researchers estimate that 40 percent of all retinoblastomas are germinal, which means that *RB1* mutations occur in all of the body's cells and can be passed to the next generation. The other 60 percent are non-germinal, which means that *RB1* mutations occur only in the eye and cannot be passed to the next generation.

In germinal retinoblastoma, an *RB1* mutation is present in all of the body's cells. For retinoblastoma to develop, the other copy of the *RB1* gene also must be mutated or lost. This second mutation typically occurs early in life in retinal cells. Cells with two altered copies of the *RB1* gene produce no functional pRB and are unable to regulate cell division effectively. As a result, retinal cells lacking functional pRB can divide uncontrollably to form cancerous tumors. Some studies suggest that additional genetic changes can influence the development of retinoblastoma; these changes may help explain variations in the development and growth of tumors in different people.

In people with germinal retinoblastoma, *RB1* mutations increase the risk of several other cancers outside the eye. Specifically, these people are more likely to develop a cancer

of the pineal gland in the brain (pinealoma), a type of bone cancer known as osteosarcoma, cancers of soft tissues such as muscle, and an aggressive form of skin cancer called melanoma.

Non-germinal retinoblastoma occurs in people with no history of the disorder in their family. Affected individuals are born with two normal copies of the *RB1* gene. Then, usually in early childhood, both copies of the gene in retinal cells acquire mutations or are lost. These non-inherited genetic changes are known as somatic mutations. Somatic mutations in both copies of the *RB1* gene prevent the cells from producing any functional pRB. The loss of this protein allows retinal cells to grow and divide without control or order, leading to the development of a cancerous tumor.

Bladder cancer

Somatic *RB1* gene mutations have been identified in people with bladder cancer. These changes prevent pRB from regulating cell division effectively, leading to uncontrolled growth and division of affected cells and tumor formation.

Cholangiocarcinoma

MedlinePlus Genetics provides information about Cholangiocarcinoma

Lung cancer

Somatic mutations in the *RB1* gene have also been found in lung cancer. As in other forms of cancer, these genetic changes make the pRB protein ineffective, and cells can grow and divide without control, forming a tumor.

Other cancers

Somatic mutations in the *RB1* gene are associated with many other types of cancer. In addition to the cancers listed above, changes in the *RB1* gene have been reported in some cases of breast cancer, melanoma, and a bone cancer known as osteosarcoma. Somatic *RB1* mutations have also been identified in some leukemias, which are cancers of blood-forming cells. Somatic *RB1* mutations in cancer cells inactivate pRB so it can no longer regulate cell division effectively.

Other Names for This Gene

- p105-Rb
- PP110
- PPP1R130
- RB
- RB1 gene
- RB_HUMAN
- retinoblastoma 1

- Retinoblastoma 1 (including osteosarcoma)
- Retinoblastoma-1
- Retinoblastoma-associated protein

Additional Information & Resources

Tests Listed in the Genetic Testing Registry

- Tests of RB1 ([https://www.ncbi.nlm.nih.gov/gtr/all/tests/?term=5925\[geneid\]](https://www.ncbi.nlm.nih.gov/gtr/all/tests/?term=5925[geneid]))

Scientific Articles on PubMed

- PubMed (<https://pubmed.ncbi.nlm.nih.gov/?term=%28%28RB1%5BTIAB%5D%29+OR+%28Retinoblastoma+1%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+360+days%22%5Bdp%5D%29%29%29>)

Catalog of Genes and Diseases from OMIM

- RB TRANSCRIPTIONAL COREPRESSOR 1; RB1 (<https://omim.org/entry/614041>)

Gene and Variant Databases

- NCBI Gene (<https://www.ncbi.nlm.nih.gov/gene/5925>)
- ClinVar ([https://www.ncbi.nlm.nih.gov/clinvar?term=RB1\[gene\]](https://www.ncbi.nlm.nih.gov/clinvar?term=RB1[gene]))

References

- Classon M, Harlow E. The retinoblastoma tumour suppressor in development and cancer. *Nat Rev Cancer*. 2002 Dec;2(12):910-7. doi: 10.1038/nrc950. Citation on PubMed (<https://pubmed.ncbi.nlm.nih.gov/12459729>)
- de Andrade AF, da Hora Barbosa R, Vargas FR, Ferman S, Eisenberg AL, Fernandes L, Bonvicino CR. A molecular study of first and second RB1 mutational hits in retinoblastoma patients. *Cancer Genet Cytogenet*. 2006 May;167(1):43-6. doi: 10.1016/j.cancergencyto.2005.08.017. Citation on PubMed (<https://pubmed.ncbi.nlm.nih.gov/16682285>)
- Du W, Pogoriler J. Retinoblastoma family genes. *Oncogene*. 2006 Aug 28;25(38):5190-200. doi: 10.1038/sj.onc.1209651. Citation on PubMed (<https://pubmed.ncbi.nlm.nih.gov/16936737>) or Free article on PubMed Central (<https://www.ncbi.nlm.nih.gov/pmc/articles/PMC1899835/>)
- Goodrich DW. The retinoblastoma tumor-suppressor gene, the exception that proves the rule. *Oncogene*. 2006 Aug 28;25(38):5233-43. doi:10.1038/sj.onc.

1209616. Citation on PubMed (<https://pubmed.ncbi.nlm.nih.gov/16936742>) or Free article on PubMed Central (<https://www.ncbi.nlm.nih.gov/pmc/articles/PMC2799241/>)

- Herwig S, Strauss M. The retinoblastoma protein: a master regulator of cell cycle, differentiation and apoptosis. *Eur J Biochem*. 1997 Jun 15;246(3):581-601. doi: 10.1111/j.1432-1033.1997.t01-2-00581.x. Citation on PubMed (<https://pubmed.ncbi.nlm.nih.gov/9219514>)
- Knudsen ES, Knudsen KE. Retinoblastoma tumor suppressor: where cancer meets the cell cycle. *Exp Biol Med (Maywood)*. 2006 Jul;231(7):1271-81. doi:10.1177/153537020623100713. Citation on PubMed (<https://pubmed.ncbi.nlm.nih.gov/16816134>)
- Korabiowska M, Ruschenburg I, Betke H, Stachura J, Schlott T, Cardo CC, Brinck U. Downregulation of the retinoblastoma gene expression in the progression of malignant melanoma. *Pathobiology*. 2001;69(5):274-80. doi: 10.1159/000064338. Citation on PubMed (<https://pubmed.ncbi.nlm.nih.gov/12107345>)
- Leiderman YI, Kiss S, Mukai S. Molecular genetics of RB1--the retinoblastoma gene. *Semin Ophthalmol*. 2007 Oct-Dec;22(4):247-54. doi:10.1080/08820530701745165. Citation on PubMed (<https://pubmed.ncbi.nlm.nih.gov/18097988>)
- Liu H, Dibling B, Spike B, Dirlam A, Macleod K. New roles for the RB tumor suppressor protein. *Curr Opin Genet Dev*. 2004 Feb;14(1):55-64. doi:10.1016/j.gde.2003.11.005. Citation on PubMed (<https://pubmed.ncbi.nlm.nih.gov/15108806>)
- Lohmann DR, Gallie BL. Retinoblastoma: revisiting the model prototype of inherited cancer. *Am J Med Genet C Semin Med Genet*. 2004 Aug 15;129C(1):23-8. doi: 10.1002/ajmg.c.30024. Citation on PubMed (<https://pubmed.ncbi.nlm.nih.gov/15264269>)
- Richter S, Vandezande K, Chen N, Zhang K, Sutherland J, Anderson J, Han L, Panton R, Branco P, Gallie B. Sensitive and efficient detection of RB1 gene mutations enhances care for families with retinoblastoma. *Am J Hum Genet*. 2003 Feb;72(2):253-69. doi: 10.1086/345651. Epub 2002 Dec 18. Citation on PubMed (<https://pubmed.ncbi.nlm.nih.gov/12541220>) or Free article on PubMed Central (<https://www.ncbi.nlm.nih.gov/pmc/articles/PMC379221/>)
- Sampieri K, Hadjililianou T, Mari F, Speciale C, Mencarelli MA, Cetta F, Manoukian S, Peissel B, Giachino D, Pasini B, Acquaviva A, Caporossi A, Frezzotti R, Renieri A, Bruttini M. Mutational screening of the RB1 gene in Italian patients with retinoblastoma reveals 11 novel mutations. *J Hum Genet*. 2006;51(3):209-216. doi: 10.1007/s10038-005-0348-3. Epub 2006 Feb 4. Citation on PubMed (<https://pubmed.ncbi.nlm.nih.gov/16463005>)
- Wolff EM, Liang G, Jones PA. Mechanisms of Disease: genetic and epigenetic alterations that drive bladder cancer. *Nat Clin Pract Urol*. 2005 Oct;2(10):502-10. doi: 10.1038/ncpuro0318. Citation on PubMed (<https://pubmed.ncbi.nlm.nih.gov/16474624>)

Genomic Location

The *RB1* gene is found on chromosome 13 (<https://medlineplus.gov/genetics/chromosome>)

me/13/).

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