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Retinoblastoma Causes, Risk Factors, and Prevention

Risk Factors

A risk factor is anything that affects your chance of getting a disease such as cancer. Learn more about the risk factors for retinoblastoma

- [Risk Factors for Retinoblastoma](#)
- [What Causes Retinoblastoma?](#)

Prevention

In adults, the risk for many cancers can be reduced by avoiding certain risk factors, such as smoking. But there are no known avoidable risk factors for retinoblastoma. If your child does develop retinoblastoma, it's important to realize that you or your child did nothing to cause it.

Some gene changes that put a child at high risk of retinoblastoma can be passed on from a parent. Children born to a parent with a history of retinoblastoma should be screened for this cancer starting shortly after birth because early detection of this cancer greatly improves the chance for successful treatment.

Risk Factors for Retinoblastoma

A risk factor is anything that increases a person's chance of getting a disease such as

cancer. Different cancers have different risk factors.

Lifestyle-related risk factors such as body weight, physical activity, diet, and tobacco use play a major role in many adult cancers. But these factors usually take many years to influence cancer risk, and they are not thought to play much of a role in childhood cancers, including retinoblastomas.

There are very few known risk factors for retinoblastoma.

Age

Most children [diagnosed](#)¹ with retinoblastoma are younger than 3 years old. Most congenital (heritable) retinoblastomas are found during the first year of life, while non-heritable retinoblastomas tend to be diagnosed in 1- and 2-year-olds. Retinoblastomas are rare after age 6.

Heredity

The risk of retinoblastoma is much higher in children with a parent who had the congenital (heritable) form of retinoblastoma. This form often results in tumors in both eyes (bilateral retinoblastoma).

But for most children with retinoblastoma, there is no family history of the disease. This is true whether they have the heritable or non-heritable form of retinoblastoma.

On the other hand, children with the heritable form of retinoblastoma have a 1 in 2 chance of eventually passing on the *RB1* gene change that causes the tumor to *their* children. Children with the non-heritable form do not pass on an increased risk.

To learn more about the causes of the heritable and non-heritable forms of retinoblastoma, see [What Causes Retinoblastoma?](#)

Unclear risk factors

Some studies have suggested some parental factors that might be linked to an increased risk of retinoblastoma, such as:

- Diets low in fruits and vegetables among mothers during pregnancy
- Exposure to chemicals in gasoline or diesel exhaust during pregnancy
- Exposure of fathers to radiation

- Older age among fathers

The possible link between these factors and retinoblastoma is still being studied.

Hyperlinks

1. www.cancer.org/cancer/retinoblastoma/detection-diagnosis-staging/how-diagnosed.html

References

Hurwitz RL, Shields CL, Shields JA, et al. Chapter 27: Retinoblastoma. In: Pizzo PA, Poplack DG, eds. *Principles and Practice of Pediatric Oncology*. 7th ed. Philadelphia, Pa: Lippincott Williams & Wilkins; 2016.

Kaufman PL, Kim J, Berry JL. Retinoblastoma: Clinical presentation, evaluation, and diagnosis. UpToDate. Accessed at www.uptodate.com/contents/retinoblastoma-clinical-presentation-evaluation-and-diagnosis on September 18, 2018.

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What Causes Retinoblastoma?

There are very few known risk factors for retinoblastoma, but the main gene changes inside cells that can lead to retinoblastoma are now fairly well known.

Early in fetal development, well before birth, cells in the retina of the eye divide to make new cells to fill the retina. At a certain point, these cells normally stop dividing and

become mature retinal cells. But sometimes something goes wrong with this process. Instead of maturing, some retinal cells continue to grow out of control, which can lead to retinoblastoma.

Certain changes in a person's DNA can cause cells of the retina to grow out of control. DNA is the chemical in each of our cells that makes up our **genes**, which control how our cells function. We usually look like our parents because they are the source of our DNA. But DNA affects much more than how we look.

Some genes control when our cells grow, divide into new cells, and die at the right time:

- Genes that help cells grow, divide, or stay alive are called **oncogenes**.
- Genes that help keep cell division under control or cause cells to die at the right time are called **tumor suppressor genes**.

Cancers can be caused by DNA changes (mutations) that keep oncogenes turned on, or that turn off tumor suppressor genes.

The most important gene in retinoblastoma is the *RB1* tumor suppressor gene. This gene makes a protein (pRb) that helps stop cells from growing too quickly. Each cell normally has two *RB1* genes. As long as a retinal cell has at least one *RB1* gene that works as it should, it will not form a retinoblastoma. But when both of the *RB1* genes are mutated or missing, a cell can grow unchecked. This can lead to further gene changes, which in turn may cause cells to become cancerous.

Heritable or bilateral retinoblastoma

About 1 out of 3 children with retinoblastoma have a **germline mutation** in one *RB1* gene; that is, the *RB1* gene mutation is in all the cells in the body. In most of these children (75%), this mutation occurs very early in development, while still in the womb. The other 25% of children inherit the gene mutation from one of their parents.

About 9 of 10 children who are born with this *RB1* germline mutation develop retinoblastoma. This happens when the second *RB1* gene is lost or mutated. Most often the retinoblastoma is **bilateral** (in both eyes), but sometimes it is found early enough that it is still only in one eye.

These children have heritable retinoblastoma (also called hereditary or congenital retinoblastoma). All bilateral retinoblastomas are considered heritable, although not all heritable retinoblastomas are bilateral when they are found.

Everybody has two *RB1* genes but passes only one on to each of their children. (The child gets the other *RB1* gene from the other parent.) Therefore there is a 1 in 2 chance that a parent who had heritable retinoblastoma will pass the mutated gene on to his or her child.

Most children with heritable retinoblastoma don't have an affected parent. But these children can still pass their *RB1* gene mutation on to their children. This is why this form of retinoblastoma is called "heritable" (even though neither of the child's parents may have been affected).

Because children with this form of retinoblastoma have *RB1* gene changes in all the cells in their body, they are also at higher risk for developing some other types of cancer. For more on this, see [After Treatment for Retinoblastoma](#)¹.

Non-heritable (sporadic) retinoblastoma

Most of the remaining 2 out of 3 children with retinoblastoma do not have the *RB1* gene mutation in all the cells of their body. Instead, the *RB1* mutation happens early in life and first occurs only in one cell in one eye. These children are not at risk for passing the gene mutation on to their offspring.

(In a very small portion of non-heritable retinoblastomas, there is no *RB1* gene mutation. Some of these retinoblastomas seem to be caused by changes in another gene, known as *MYCN*.)

Whether the changes in the *RB1* gene are heritable or sporadic, it's not clear what causes these changes. They may result from random gene errors that sometimes occur when cells divide to make new cells. There are no known lifestyle-related or environmental causes of retinoblastoma, so it's important to remember that there is nothing these children or their parents could have done to prevent these cancers.

Hyperlinks

1. www.cancer.org/cancer/retinoblastoma/after-treatment/follow-up.html

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Hurwitz RL, Shields CL, Shields JA, et al. Chapter 27: Retinoblastoma. In: Pizzo PA, Poplack DG, eds. *Principles and Practice of Pediatric Oncology*. 7th ed. Philadelphia, Pa: Lippincott Williams & Wilkins; 2016.

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Can Retinoblastoma Be Prevented?

In adults, the risk for many cancers can be reduced by avoiding certain risk factors, such as smoking or exposure to hazardous chemicals in the workplace. But there are no known avoidable risk factors for retinoblastoma. If your child has retinoblastoma, it's important to know that you or your child did nothing to cause it.

In some cases, parents who had the [heritable form of retinoblastoma](#) can pass on the *RB1* gene change that increases risk to their children. People who have had retinoblastoma might want to consider [genetic counseling](#)¹ before having children to learn more about the risks of passing on this gene change and perhaps to explore ways to avoid this. For example, an option some people might consider would be to use in vitro fertilization (IVF) and implant only embryos that don't have the gene change.

If a preventive option is not used, children born to a parent with a history of retinoblastoma should be screened carefully for this cancer starting shortly after birth, because early detection of this cancer greatly improves the chance for successful treatment. See [Can Retinoblastoma Be Found Early?](#)² for more information.

Hyperlinks

1. www.cancer.org/cancer/cancer-causes/genetics/what-happens-during-genetic-testing-for-cancer.html
2. www.cancer.org/cancer/retinoblastoma/detection-diagnosis-staging/detection.html

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