Brain and Spinal Cord Tumor in Adults
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 brain and spinal cord tumors.

- Risk Factors for Brain and Spinal Cord Tumors
- What Causes Brain and Spinal Cord Tumors in Adults?

Prevention

Other than radiation exposure, there are no known lifestyle-related or environmental causes of brain and spinal cord tumors, so at this time there is no known way to protect against most of these tumors.

Risk Factors for Brain and Spinal Cord Tumors

A risk factor is anything that affects your chance of getting a disease such as a brain or spinal cord tumor. Different types of cancer have different risk factors. Some risk factors, like smoking, you can change. Others, like your age or family history, can’t be changed.
But having a risk factor, or even several, does not always mean that a person will get the disease, and many people get tumors without having any known risk factors.

Most brain tumors are not linked with any known risk factors and have no obvious cause. But there are a few factors that can raise the risk of brain tumors.

**Radiation exposure**

The best known environmental risk factor for brain tumors is radiation exposure\(^1\), most often from radiation therapy to treat some other condition. For example, before the risks of radiation were known, children with ringworm of the scalp (a fungal infection) were sometimes treated with low-dose radiation therapy, which was later found to increase their risk of brain tumors as they got older.

Today, most radiation-induced brain tumors are caused by radiation to the head given to treat other cancers. They occur most often in people who received radiation to the brain as children as part of their treatment for leukemia\(^2\). These brain tumors usually develop around 10 to 15 years after the radiation.

Radiation-induced tumors are still fairly rare, but because of the increased risk (as well as the other side effects), radiation therapy is only given to the head after carefully weighing the possible benefits and risks. For most patients with other cancers involving the brain or head, the benefits of radiation therapy far outweigh the risk of developing a brain tumor years later.

The possible risk from exposure to imaging tests\(^3\) that use radiation, such as x-rays or CT scans, is not known for sure. These tests use much lower levels of radiation than those used in radiation treatments, so if there is any increase in risk, it is likely to be very small. But to be safe, most doctors recommend that people (especially children and pregnant women) not get these tests unless they are clearly needed.

**Family history**

Most people with brain tumors do not have a family history of the disease, but in rare cases brain and spinal cord cancers run in families. In general, patients with familial cancer syndromes tend to have many tumors that first occur when they are young. Some of these families have well-defined disorders, such as:

**Neurofibromatosis type 1 (NF1)**
This genetic disorder, also known as von Recklinghausen disease, is the most common syndrome linked to brain or spinal cord tumors. People with this condition have higher risks of schwannomas, meningiomas, and certain types of gliomas, as well as neurofibromas (benign tumors of peripheral nerves). Changes in the \textit{NF1} gene cause this disorder. These changes are inherited from a parent in about half of all cases. In the other half, the \textit{NF1} gene changes occur before birth in people whose parents did not have this condition.

\textbf{Neurofibromatosis type 2 (NF2)}

This condition, which is much less common than NF1, is associated with vestibular schwannomas (acoustic neuromas), which almost always occur on both sides of the head. It is also linked with an increased risk of meningiomas or spinal cord ependymomas. Changes in the \textit{NF2} gene are usually responsible for neurofibromatosis type 2. Like \textit{NF1}, the gene changes are inherited in about half of cases. In the other half, they occur before birth in children without a family history.

\textbf{Tuberous sclerosis}

People with this condition may have subependymal giant cell astrocytomas (SEGAs), which are low-grade astrocytomas that develop beneath the ependymal cells of the ventricles. They may also have other benign tumors of the brain, skin, heart, kidneys, and other organs. This condition is caused by changes in either the \textit{TSC1} or the \textit{TSC2} gene. These gene changes can be inherited from a parent, but most often they develop in people without a family history.

\textbf{Von Hippel-Lindau disease}

People with this condition tend to develop benign or cancerous tumors in different parts of the body, including hemangioblastomas (benign blood vessel tumors) in the brain, spinal cord, or retina, as well as tumors of the inner ear, kidney, adrenal gland, and pancreas. It is caused by changes in the \textit{VHL} gene. Most often the gene changes are inherited, but in some cases the changes happen before birth in people whose parents don’t have them.

\textbf{Li-Fraumeni syndrome}

People with this condition are at higher risk for developing gliomas, along with breast cancer\textsuperscript{4}, soft tissue sarcomas\textsuperscript{5}, leukemia\textsuperscript{6}, adrenal gland cancer\textsuperscript{7}, and certain other types of cancer. It is caused by changes in the \textit{TP53} gene.
Other syndromes

Other inherited conditions are also linked with increased risks of certain types of brain and spinal cord tumors, including:

- Gorlin syndrome (basal cell nevus syndrome)
- Turcot syndrome
- Cowden syndrome

Some families may have genetic disorders that are not well recognized or that may even be unique to a particular family.

Having a weakened immune system

People with weakened immune systems have an increased risk of developing lymphomas\(^8\) of the brain or spinal cord (known as primary CNS lymphomas). Lymphomas are cancers of lymphocytes, a type of white blood cell that fights disease. Primary CNS lymphoma is less common than lymphoma that develops outside the brain.

A weakened immune system can be congenital (present at birth), or it can be caused by treatments for other cancers, treatment to prevent rejection of transplanted organs, or diseases such as acquired immunodeficiency syndrome\(^9\) (AIDS).

Factors with uncertain, controversial, or unproven effects on brain tumor risk

Cell phone use

Cell phones give off radiofrequency (RF) rays\(^10\), a form of energy on the electromagnetic spectrum between FM radio waves and those used in microwave ovens, radar, and satellite stations. Cell phones do not give off ionizing radiation\(^11\), the type that can cause cancer by damaging the DNA inside cells. Still, there have been concerns that the phones, whose antennae are built-in and therefore are placed close to the head when being used, might somehow raise the risk of brain tumors.

Some studies have suggested a possible increased risk of brain tumors or of vestibular schwannomas (acoustic neuromas) with cell phone use, but most of the larger studies done so far have not found an increased risk, either overall or among specific types of tumors. Still, there are very few studies of long-term use (10 years or more), and cell
phones haven’t been around long enough to determine the possible risks of lifetime use. The same is true of any possible higher risks in children, who are increasingly using cell phones. Cell phone technology also continues to change, and it’s not clear how this might affect any risk.

These risks are being studied, but it will probably be many years before firm conclusions can be made. In the meantime, for people concerned about the possible risks, there are ways to lower your exposure, such as using the phone’s speaker or an earpiece to move the phone itself away from the head.

For more on this topic, see Cellular Phones¹².

Other factors

Other environmental factors such as exposure to vinyl chloride (a chemical used to manufacture plastics), petroleum products, and certain other chemicals have been linked with an increased risk of brain tumors in some studies but not in others.

Exposure to aspartame¹³ (a sugar substitute), exposure to electromagnetic fields from power lines¹⁴ and transformers, and infection with certain viruses¹⁵ have been suggested as possible risk factors, but most researchers agree that there is no convincing evidence to link these factors to brain tumors. Research on these and other possible risk factors continues.

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What Causes Brain and Spinal Cord Tumors in Adults?

The cause of most brain and spinal cord tumors is not fully understood, and there are very few well-established risk factors. But researchers have found some of the changes that occur in normal brain cells that may lead them to form brain tumors.
Normal human cells grow and function based mainly on the information contained in each cell’s DNA. Brain and spinal cord tumors, like other tumors, are caused by changes in the DNA inside cells. DNA is the chemical 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 more than how we look.

Some genes control when our cells grow, divide into new cells, and die:

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

Cancers can be caused by DNA changes that turn on oncogenes or turn off tumor suppressor genes. These gene changes can be inherited from a parent, but more often they happen during a person’s lifetime.

**Inherited gene changes**

Researchers have found gene changes that cause some rare inherited syndromes (like neurofibromatosis, tuberous sclerosis, Li-Fraumeni syndrome, and von Hippel-Lindau syndrome) and increase the risk of developing some brain and spinal cord tumors. For example, the Li-Fraumeni syndrome is caused by changes in the TP53 tumor suppressor gene. Normally, this gene prevents cells with damaged DNA from growing. Changes in this gene increase the risk of developing brain tumors (particularly gliomas), as well as some other cancers.

**Gene changes acquired during a person’s lifetime**

Most often, it’s not known why people without inherited syndromes develop brain or spinal cord tumors. Most exposures that cause cancer somehow damage DNA. For example, tobacco smoke is a risk factor for lung cancer and several other cancers because it contains chemicals that can damage the genes inside cells. The brain is relatively protected from tobacco smoke and other cancer-causing chemicals that we might breathe in or eat, so these factors are not likely to play a major role in these cancers.

Several different gene changes usually occur in normal cells before they become cancerous. There are many kinds of brain tumors, each of which may have different sets of gene changes. A number of gene changes have been found in different brain tumor types, but there are probably many others that have not yet been found.
Researchers now understand some of the gene changes that occur in different types of brain tumors, but it’s still not clear what causes most of these changes. Some gene changes might be inherited, but most brain and spinal cord tumors are not the result of known inherited syndromes. Other than radiation\(^3\), no known lifestyle-related or environmental factors are clearly linked to brain tumors. Most gene changes are probably just random events that sometimes happen inside a cell, without having an outside cause.

**Hyperlinks**


**References**


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**Can Brain and Spinal Cord Tumors in Adults Be Prevented?**

The risk of many cancers in adults can be reduced with certain lifestyle changes (such
as staying at a healthy weight or quitting smoking). But other than radiation exposure\(^1\), there are no known lifestyle-related or environmental risk factors\(^2\) for brain and spinal cord tumors, so at this time there is no known way to protect against most of these tumors.

**Limiting radiation exposure to the head**

For most people with other types of cancer in or near the head, radiation therapy\(^3\) may be given if doctors feel the benefits outweigh the small risk of developing a brain tumor years later. Still, when it is needed, doctors try to limit the dose of radiation as much as possible.

Imaging tests\(^4\) such as x-rays or CT scans use much lower levels of radiation than those used for cancer treatment. If there is any increase in risk from these tests, it is likely to be very small, but to be safe, most doctors recommend that people (especially pregnant women and children) not get these tests unless they are absolutely needed.

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**References**


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