

Causes & Risk Factors

No risk factor accounting for the majority of brain tumors has been identified even though many environmental and genetic factors have been, and are, being studied. However, there are many groups across the United States and around the world focused on discovering the causes and/or risk factors for brain tumors.

Brain tumor epidemiologists look for causes and risk factors that would explain why people develop brain tumors. Causes and risk factors can be environmental, such as being exposed to poisonous substances in the home or at work, eating or not eating certain foods, or whether or not we exercise/smoke cigarettes/drink alcohol. They can be genetic, such as being born with a mutation/susceptibility that one inherits from parents. Or, these genetic mutations/susceptibilities may accumulate over time, as one grows older.

Environmental Factors

Many studies have examined a wide spectrum of environmental factors as a cause for brain tumors. Of the long list of factors studied, only exposure to ionizing radiation has consistently been shown to put one at *increased* risk for developing a brain tumor. Some studies have shown a history of allergies as an adult, a mother eating fruits and vegetables during pregnancy, eating fruits and vegetables as a child, and having chicken pox as a child puts one at a *decreased* risk of development of brain tumors.

However, environmental exposures can be difficult to accurately measure leading to inconsistent results across studies. Therefore, inconsistent results have been found, in both adults and children, for a long list of environmental factors. These factors include: vinyl chloride exposure, working in synthetic rubber manufacturing or petroleum refining/production, history of head trauma, epilepsy, seizures or convulsions, cured food consumption (nitrites), viruses and common infections, cigarette smoking, alcohol consumption, cell phone use (in the United States and in Europe), residential power line exposure, exposure to air pollution, smoking when pregnant, second hand smoke exposure, agricultural worker exposures, industrial formaldehyde exposure and use of common drugs (for example, birth control pills, sleeping pills, headache medication, over-the-counter pain medication, antihistamines). More studies need to be performed before we can say whether or not these are true risk factors for developing a brain tumor.

Genetic Factors

Anything that refers to our genes can be called “genetic”. However, only 5–10% of all cancer is actually inherited from one generation to another in a family (i.e. “heredity”). Hence, there are very few families where multiple people in that family would have a brain tumor. There are a few rare, hereditary genetic syndromes that involve brain tumors. In those syndromes, a mutation in a specific gene is passed from grandparent, to parent, to child. These syndromes, along with the inherited gene, are: NF1 (NF1 gene), NF2 (NF2 gene), Turcots (APC gene), Gorlins (PTCH gene), tuberous sclerosis (TSC1 and TSC2 genes) and Li-Fraumeni syndrome (TP53 gene).

The vast majority of genetic risk factors are not inherited at birth but actually accumulate over time as we age. Genes are the operating instructions for the entire body. While most of our genes go about their jobs as expected, a small number may become inactive or begin functioning abnormally. The end result of an abnormal gene can be as simple as two different colored eyes or as complex as the onset of a disease. There are many different types of genes thought to be working incorrectly in brain tumors:

- *Tumor suppressor genes* make proteins that stop tumor growth in normal cells. The most well-defined tumor suppressor gene is TP53, which is believed to play a role in causing a low-grade brain tumor to develop into a high-grade brain tumor.
- *Oncogenes* make proteins that cause cells to grow in an out-of-control manner.
- *Growth factors* play a role in making sure that cells grow normally. EGFR is a growth factor that has been well studied in brain tumors and has been shown to be in very high quantities in high-grade brain tumors, causing these tumors to grow abnormally fast.
- *Cyclin-dependent kinase inhibitors* play a role in making sure that the cell goes through its growth cycle normally.

- *DNA repair genes* make proteins that control accurate repair of damaged DNA. ERCC1 is a DNA repair gene that has been shown to be associated with oligodendrogliomas but not with GBMs.
- *Carcinogen metabolizing genes* make proteins that break down toxic chemicals in the body that could cause damage to one's DNA, like the chemicals in cigarette smoke and/or alcohol.
- *Immune response genes* make proteins that control how one's immune system responds to viruses and infections.

However, studies of any specific gene are complicated by the fact that there are many potential genes in the human genome to consider. One must also consider that many of these genes interact with one another, and they may interact with environmental factors as well.

Tumors can also have loss or gain of certain pieces of *chromosomes*. Each normal cell in any human body has 23 pairs of chromosomes, 22 autosomal pairs and one sex pair (two X chromosomes make a female and one X chromosome and one Y chromosome make a male). The most common chromosomal changes in brain tumors occur on chromosomes 1, 10, 13, 17, 19 and 22. Changes on chromosomes 1 and 19 are most frequently found in oligodendrogliomas and changes on chromosome 22 are most frequently found in meningiomas.

Medline Searches

To learn more about potential causes of brain tumors, you can perform a medical literature search on the Internet using Medline, a medical literature search program offered by the National Library of Medicine. Medline can be found at www.nlm.nih.gov. This computer program searches medical journals (the journals scientists read) for articles containing the keywords and limits you specify. It has an easy "fill-in-the-blank" format and online help options.

We can also e-mail step-by-step instructions for performing your own Medline Search. Call us at 800-886-2282 or send a message to info@abta.org.

Questions About Heredity

"My family member has a brain tumor. Should I be tested too?" Concerns about heredity and brain tumors are common, and if you have concerns about your family history, we suggest the following:

- Begin by sharing your family's medical history with your primary physician. He or she will want to know the type of brain tumor and your relation to the person with the tumor. Although routine screening for brain tumors is not available as it is for breast or cervical cancer, unusual symptoms — such as headaches or short term memory loss — can be investigated with your family history in mind.
- If you have multiple family members diagnosed with brain tumors, or have concerns about starting a family, consider a consultation with a genetic counselor. He or she can access the latest genetic information related to the specific tumor type in your family and advise you accordingly. The Cancer Information Service at 800-422-6237 can help you find a genetic counselor.