

Fact Sheet



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Who Gets Brain Tumors and Why?

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Who gets brain tumors?

About 29,000 people in the U.S. are diagnosed with primary brain tumors each year, and nearly 13,000 people die. In children, brain tumors are the cause of one quarter of all cancer deaths. The overall annual incidence of primary brain tumors in the U.S. is 11 to 12 per 100,000 people. For primary malignant brain tumors, that rate is 6 to 7 per 100,000.

What explains the dramatic increase in brain tumors over the past three decades?

Most studies in developed countries show that the number of people who develop brain tumors and die from them has increased—perhaps as much as 300%—over the past three decades. The greatest increase has been among people 75 years or older and is likely to be the result of better diagnostic procedures such as CAT scans and MRIs, greater availability of neurosurgeons, and a changing attitude toward diagnosis in the elderly. But many researchers also suggest some of the increase, particularly in childhood brain tumors, may be due to other, unknown causes. Environmental factors are suspected, although no major culprits have been identified.

Are brain tumors more common in certain countries or among particular ethnic groups?

Areas with the highest reported rates of primary malignant brain tumors, such as Northern Europe, the United States, and Israel generally have more accessible medical care than areas with the lowest rates, such as India or the Philippines. This would seem to indicate that the disparity is due to better diagnosis and reporting of brain tumors in more developed countries. However, there is some evidence that ethnic differences do play a role in the disease. For example, the rate of malignant brain tumors in Japan, an economically prosperous country, is less than half the rate of Northern Europe's. And in the United States, whites have higher rates of glioma, but lower rates of meningioma than blacks.

Are older people at greater risk?

Yes. The average age of onset of primary brain tumors is 53, while for both glioblastoma and meningioma the average age of onset is 62. Different types of tumors appear to be more common to particular ages, but overall, the greatest incidence appears to be in people 65 and older. As with other types of cancer, the increasing incidence of most types of brain tumors with age could be due to the length of exposure required for cells to become malignant or to an aging immune system's decreasing abilities to protect against disease.

What role does gender play in brain tumor risk?

Glioma is more common in men, while meningioma is more common in women. This is the most consistent finding in epidemiological studies of brain tumors.

What other risk factors are associated with brain tumors?

Most researchers agree that certain inherited genes and radiation treatments for cancer or other diseases are risks for primary brain tumors. There is little consensus on other possible risk factors. Studies on the role of prenatal exposure to radiation in childhood brain tumors are inconclusive, and evidence that diagnostic radiation (such as dental x-rays) plays a role in the development of glioma is not strong. It appears that employees at nuclear facilities and nuclear materials production workers run a slightly greater risk, but that conclusion is clouded by these workers' exposure to other chemicals. One reason little is known about specific risk factors is that there are so many different kinds of primary brain tumors and so few large-scale studies of these specific types.

If genes play a role in the development of brain tumors, does that mean they run in families?

Some people have a rare gene or chromosomal abnormality that greatly increases their chance of developing brain tumors. Yet "genetic predisposition," as it is called, probably accounts

for less than five percent of brain tumors. In families with Li-Fraumeni syndrome (LFS), for example, there is an increased risk of developing certain types of cancers, including brain tumors. LFS has been linked to a gene mutation in p53 on chromosome 17p. Further research needs to be done to determine the role of heredity and the frequency of p53 mutations. Other people may have what researchers call a “genetic susceptibility” for developing cancer. Their bodies may not be as efficient at metabolizing certain substances, eliminating carcinogens, or repairing damaged DNA. When exposed to toxic environmental agents, they may more easily develop cancer. Because such a small proportion of brain tumors is attributed purely to heredity, it seems likely that the majority is associated with these or other gene-environment interactions.

Do illnesses cause brain tumors?

Several types of viruses have been shown to cause brain tumors in experimental animal studies, but because it is so difficult to design meaningful studies on humans, the topic has received little attention. Dr. Wrensch and colleagues did find that adults in the San Francisco Bay Area with glioma were significantly less likely to have had either chicken pox or shingles than control groups. This finding, along with results from other studies indicating that people with brain cancer are less likely than people without to report a history of allergies and common infections, suggests that further work on the role of common infections and allergies in preventing brain tumors may be warranted.

Do head injuries or seizures cause brain tumors?

Serious head trauma has long been suspected as a cause of brain tumors. In fact, studies show a positive association between head trauma and meningioma, but a negative link to glioma. A history of seizures has been fairly consistently associated with brain tumors, but since brain tumors are known to cause seizures, it is unclear if seizures and/or seizure medication can increase tumor risk. As for drugs and medications, there have been few studies of their link to adult brain tumors. Because non-steroidal, anti-inflammatory drugs may be protective against certain cancers, these drugs should be investigated for their effectiveness against brain tumors.

Does diet cause brain tumors?

In animal studies, certain chemical substances known as N-nitroso compounds have been clearly identified as carcinogenic to the nervous system. But determining how humans are affected is extremely complicated because there are so many sources of exposure to N-nitroso compounds. Cigarette

smoke, cosmetics, cured meats, and even automobile interiors are sources of these chemical compounds, yet they make up only about half the sources to which humans are exposed. The rest come from inside the body as the digestive process breaks down foods (including vegetables) and drugs. Given the great amount of exposure to these compounds and the variety of sources, it is extremely difficult to determine any individual's lifetime exposure. Some studies of diet and vitamin supplementation seem to indicate that dietary N-nitroso compounds might influence the risk of both childhood and adult brain tumors. Researchers have observed in some studies that brain tumor patients (or their mothers) have generally consumed more cured foods than control groups. Recently, Drs. Lee, Wrensch and others found that adults with glioma were more likely to consume diets high in cured foods and low in vitamin C-rich fruits and vegetables, and to consume diets high in nitrites and low in vitamin C. The effect was more pronounced in men than women. However, the pattern of increased risk with increased consumption of cured foods, and decreased risk with greater consumption of fruits, vegetables, and antioxidant vitamins is compatible with other cancer studies that show increased consumption of vegetables and possibly of fruits is associated with decreased cancer risk.

Are pesticides implicated in brain tumor risk?

Studies of chemical exposures in the home have focused on the role of pre- and postnatal pesticide exposures in childhood brain tumors. Although results have been somewhat mixed, a recent large study found significantly increased risk in children exposed before birth to flea and tick pesticides. The authors of the study have urged that further investigation of pesticide exposures during pregnancy be undertaken. Although adults engaged in manufacturing pesticides or fertilizers have not been found to have increased risk, four out of five studies of pesticide applicators have shown there is an elevated risk for these professionals.

Does working in certain industries or occupations increase risk?

Armed with the knowledge that some workers are exposed to carcinogenic or toxic substances in the workplace, researchers have attempted to pinpoint possible links to brain tumors. But they've been hampered in their search because workers are rarely exposed to one single chemical, and certain chemicals probably interact with others to increase or decrease risk. Even in large studies, the number of brain tumor cases has been too small to ferret out specific causes with any certainty. Therefore, they have been unable to make any definitive links between brain tumors and specific chemicals, even

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those known to be carcinogenic. Although there has been compelling evidence that workers in the production of synthetic rubber and polyvinyl chloride are at greater risk for developing brain tumors, studies are contradictory and inconclusive. And in more than 30 studies of human cancers and formaldehyde exposure, researchers did not find an increased risk of brain tumor among industrial workers.

Are workers in the petrochemical industry at greater risk?

After 20 years of research, “the accumulated evidence suggests a cautious ‘yes,’” writes Dr. Wrensch. Researchers have focused attention on petrochemical production and oil refinery workers since the 1970s when clusters of brain tumor cases were reported in several Texas petrochemical plants. The preponderance of studies has shown increased risks of brain tumor mortality with work in these industries, although researchers do not know why.

Does exposure to electromagnetic fields cause brain tumors?

Possibly. “There are very informed people on both sides of this question,” says Dr. Wrensch. A number of studies have shown a significantly increased risk of 10 to 20 percent for brain cancer among electrical workers. But electrical workers exposed to higher levels of electromagnetic fields did not generally have a greater risk than workers exposed to lower levels. Recent studies do not show that the electromagnetic fields in residential settings increase the risk of brain tumors. Again, however, there is difficulty in measuring the intensity of electromagnetic fields in a residential setting. Another limitation with studies of EMF exposures and adult brain tumors is that the pertinent exposure period is unknown, and the way in which EMF exposure might contribute to brain tumor risk is unknown. There is no evidence to suggest that power frequency electromagnetic fields can cause cellular mutations, and the evidence that such exposures might promote tumors is hotly debated. Studies that show positive residential and occupational findings could possibly be due to undiscovered factors that are associated both with brain tumors and high electromagnetic field exposures. One such potential exposure, long

suspected as a possible factor in brain cancer, is polychlorinated biphenyls (PCBs). Although recent evidence does not show that these compounds cause brain cancer, further study is warranted.

Does a parent's exposure to certain substances play a role in childhood brain tumors?

Researchers have hypothesized that parents may increase the risk of cancer in their children three ways: through damage to the father's DNA prior to conception, by maternal exposures during pregnancy, and by postnatal exposures to infectious agents or chemicals that parents bring home from the workplace on their clothing or skin. Studies indicate significantly elevated risks of brain tumors in children whose fathers work with paper and pulp, solvents, painting, printing, and graphic arts; oil or chemical refining; farming; and metallurgy. Positive and negative findings have been reported for paternal employment in the aerospace industries. Prenatal maternal alcohol consumption is associated with a slight risk of childhood brain tumors, although maternal or environmental tobacco smoke seems to have no important affect on brain tumors developing in childhood. Several studies of parental work with hydrocarbons have not shown positive associations with risk of childhood brain tumors, while research into pre- and postnatal maternal exposures has been too contradictory to provide any conclusions.

Because cosmetics are considered to be an important environmental source of N-nitroso compounds, studies have examined maternal exposures to cosmetics. None have shown a positive risk.

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