

# Brain & Other Central Nervous System Tumors in Ohio, 2009-2013

## Key Findings and Populations at High Risk

- *An average of 879 cases of brain and other central nervous system (CNS) cancer were diagnosed each year in Ohio in 2009-2013.*
- *The mortality rate for brain and other CNS cancer in Ohio was similar to the national rate during this time period.*
- *Brain and other CNS cancer incidence rates were about 40 percent higher in males than in females and 70 percent higher in whites than blacks in Ohio and the United States in 2009-2013.*
- *Brain and other CNS cancer was most frequently diagnosed in people aged 55 to 64 during 2009-2013.*
- *In Ohio, brain and other CNS cancer mortality rates were stable from 2000 to 2013.*
- *In Ohio, 74 percent of brain and other CNS cancers were diagnosed at an early (local) stage.*
- *In the United States, the five-year relative survival probability for patients with brain and other CNS cancer was 34 percent in 2006-2012.*
- *There were more non-malignant than malignant brain and other CNS tumors diagnosed in Ohio during 2009-2013.*

## Introduction

Brain tumors are the growth of abnormal cells in the tissues of the brain. These tumors may be either malignant (cancerous) or benign (not cancerous). This report highlights primary brain and other central nervous system (CNS) tumors—those that start in the brain, spinal cord, cranial nerves or other nerves of the nervous system. Tumors that start in another part of the body and spread to the brain and nervous system are called metastatic tumors and are different from primary brain tumors. The definition of brain and other CNS tumors used in this report includes sites for brain, meninges and other central nervous system tumors. Other tumors that start in or near the brain, such as pituitary tumors and CNS lymphomas, are not included in this category and are discussed separately.

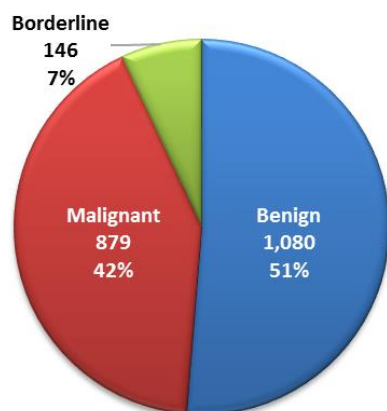
**Malignant** brain and other CNS tumors are likely to grow rapidly and crowd or invade the nearby healthy brain tissue. Unlike other cancers, tumors that start in the brain or spinal cord seldom spread to distant organs. Cancers of the brain and other CNS made up 1.4 percent of the incident (newly diagnosed) invasive cancers reported to Ohio's central cancer registry, the Ohio Cancer Incidence Surveillance System (OCISS), from 2009 to 2013. The most common type of malignant brain and other CNS tumor is glioma.

**Benign** brain and other CNS tumors represent over half of all primary brain and other CNS tumors. Benign brain and other CNS tumors rarely invade tissues around them or spread to other parts of the body. However, benign tumors can press on sensitive areas of the brain and cause serious health problems. As of 2004, benign brain and other CNS tumors are required to be reported to the OCISS and are included in this report. The most common type of benign brain and other CNS tumor is meningioma.

**Borderline** tumors have borderline malignancy, low malignant potential or uncertain malignant potential. Borderline tumors are grouped with benign tumors throughout this report.

## Brain & Other CNS Tumors by Behavior

**Figure 1. Brain & Other CNS Tumor Incidence by Behavior in Ohio, 2009-2013**



The behavior of a tumor is the way it acts within the body. Figure 1 shows the average annual number and proportion of brain and other CNS tumors reported to OCIS from 2009 to 2013 by behavior (benign, malignant and borderline).

- In Ohio, benign brain and other CNS tumors represent more than half (51 percent) of all primary brain and other CNS tumors.
- Malignant tumors made up about 42 percent of cases diagnosed in 2009-2013.
- About 7 percent of cases were reported as borderline.

Source: Ohio Cancer Incidence Surveillance System, Ohio Department of Health, 2016.  
CNS= Central Nervous System

## Brain & Other CNS Cancer Incidence and Mortality by Sex and Race

An average of 879 cases of brain and other CNS cancers were diagnosed annually in Ohio in 2009-2013 (Table 1). The average annual age-adjusted incidence rate for brain and other CNS cancer in Ohio during 2009-2013 was 6.9 cases per 100,000 persons, which was 8 percent higher than the national (SEER) incidence rate of 6.4 cases per 100,000. The incidence rate of brain and other CNS cancer was more than 40 percent higher in males than in females in Ohio and the United States in 2009-2013. The incidence rate for whites was considerably higher than blacks and Asian/Pacific Islanders in both Ohio and the United States.

An average of 589 deaths from brain and other CNS cancer occurred each year in Ohio in 2009-2013. The Ohio age-adjusted mortality rate of 4.4 deaths per 100,000 for brain and other CNS cancer was similar to the U.S. rate of 4.3 deaths per 100,000. Similar to incidence, males had a higher mortality rate for brain and other CNS cancer than females, and the mortality rate for whites was considerably higher than blacks and Asian/Pacific Islanders in both Ohio and the United States based on 2009-2013 deaths.

**Table 1. Brain & Other CNS Cancer: Average Annual Number of Cancer Cases and Deaths and Age-adjusted Incidence and Mortality Rates per 100,000 by Sex and Race in Ohio and the United States, 2009-2013**

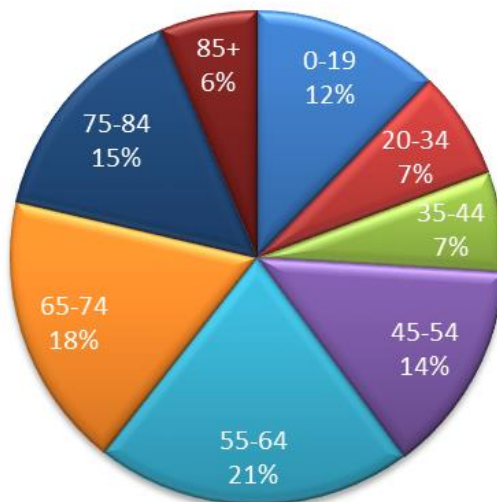
Brain & Other CNS Cancer		Incidence			Mortality		
		Ohio Cases	Ohio Rate	U.S. Rate	Ohio Deaths	Ohio Rate	U.S. Rate
<b>Total</b>		879	6.9	6.4	589	4.4	4.3
Sex	Male	490	8.2	7.6	329	5.4	5.3
	Female	389	5.7	5.4	260	3.6	3.5
Race	White	800	7.2	7.1	551	4.7	4.7
	Black	60	4.2	4.1	32	2.4	2.5
	Asian/Pacific Islander	7	3.7	3.7	5	2.9	2.0

Sources: Ohio Cancer Incidence Surveillance System, Ohio Department of Health, 2016; Surveillance, Epidemiology and End Results (SEER) Program, National Cancer Institute, 2016; Chronic Disease Epidemiology and Evaluation Section and the Bureau of Vital Statistics, Ohio Department of Health, 2016; National Center for Health Statistics, 2016.  
CNS = Central Nervous System

## Brain & Other CNS Cancer Incidence by Age Group

Figure 2 shows the percent of new malignant cases of brain and other CNS cancer by age group in Ohio during 2009-2013. In Ohio, brain and other CNS cancer was most frequently diagnosed in people ages 55 to 64, followed by people ages 65 to 74. About 12 percent of malignant brain and other CNS tumors occurred in children and adolescents (ages 0-19). Brain and other CNS cancer is the most common cancer among children (ages 0-14).

**Figure 2. Brain & Other CNS Cancer: Percent of Cancer Cases by Age Group in Ohio, 2009-2013**



Source: Ohio Cancer Incidence Surveillance System, Ohio Department of Health, 2016.

CNS = Central Nervous System

## Benign/Borderline Brain & Other CNS Tumor Incidence by Sex and Race

An average of 1,226 cases of benign/borderline brain and other CNS tumors were diagnosed annually in Ohio in 2009-2013 (Table 2). The age-adjusted incidence rate for benign/borderline brain and other CNS tumors during 2009-2013 was 9.6 cases per 100,000, which was 18 percent lower than the national (SEER) incidence rate of 11.7 cases per 100,000. Benign/borderline brain and other CNS tumors occurred in almost twice as many females than males in Ohio during 2009-2013. In contrast to malignant tumors, blacks had higher rates of benign/borderline tumors than whites and Asians/Pacific Islanders.

**Table 2. Benign/Borderline Brain & Other CNS Tumors: Average Annual Number of Cases and Age-adjusted Incidence Rates per 100,000 by Sex and Race in Ohio and the United States, 2009-2013**

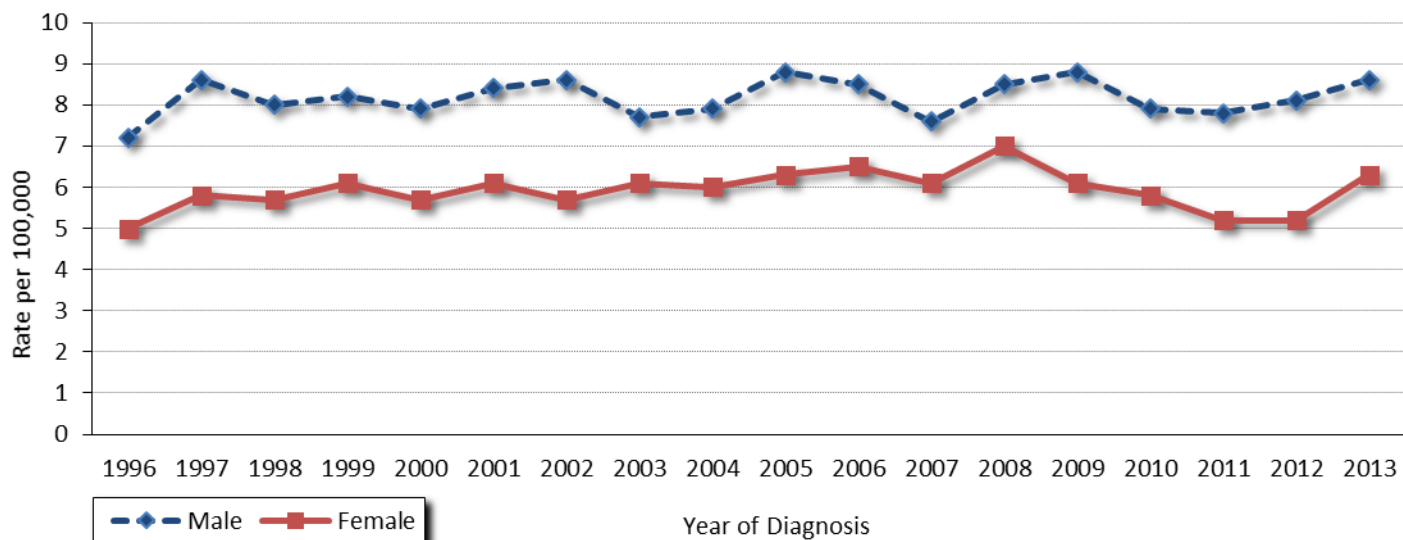
Benign/Borderline Brain & Other CNS Tumors		Ohio Cases	Ohio Rate	U.S. Rate
<b>Total</b>		1,226	9.6	11.7
Sex	Male	413	7.0	8.3
	Female	813	11.8	14.6
Race	White	1,059	9.5	11.8
	Black	134	10.0	12.0
	Asian/Pacific Islander	11	8.0	9.3

Sources: Ohio Cancer Incidence Surveillance System, Ohio Department of Health, 2016; Surveillance, Epidemiology and End Results (SEER) Program, National Cancer Institute, 2016.

CNS = Central Nervous System

## Brain & Other CNS Cancer Trends

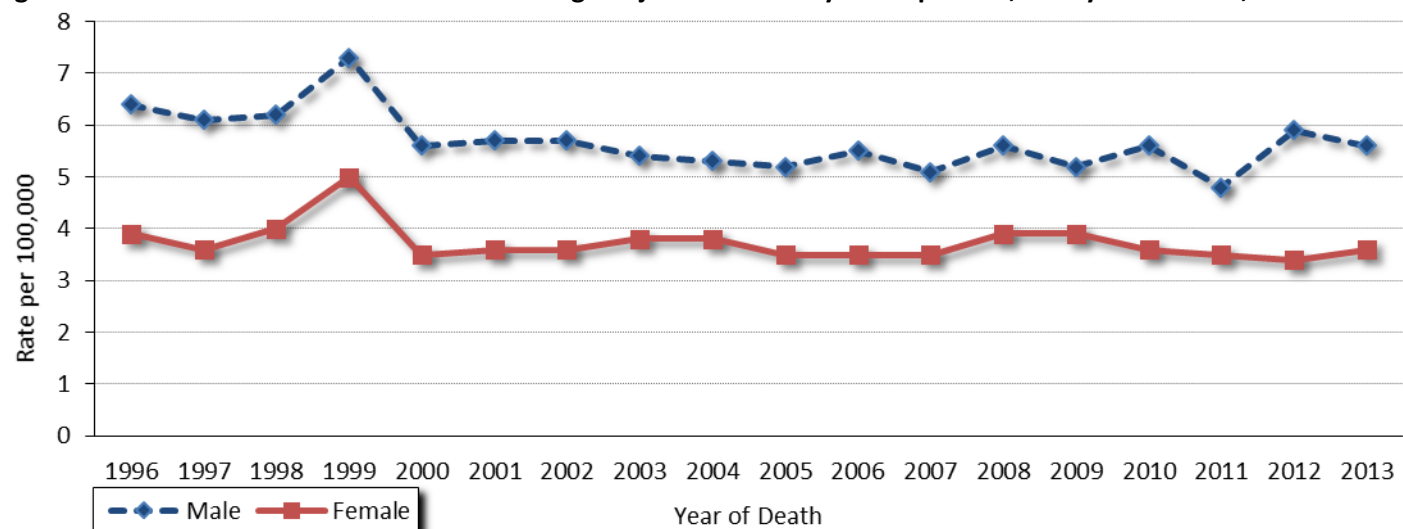
**Figure 3. Brain & Other CNS Cancer: Trends in Age-adjusted Incidence Rates per 100,000 by Sex in Ohio, 1996-2013**



Source: Ohio Cancer Incidence Surveillance System, Ohio Department of Health, 2016.  
CNS = Central Nervous System

Figure 3 shows incidence rates of brain and other CNS cancer in Ohio according to year of diagnosis (1996 to 2013) by sex. Incidence rates among males were greater than those among females for each year. Between 1996 and 2013, brain and other CNS cancer incidence rates among males and females were variable but increased 19 and 26 percent, respectively. This increase is not fully understood, but may result from increased use of neuroimaging techniques to diagnose brain tumors.

**Figure 4. Brain & Other CNS Cancer: Trends in Age-adjusted Mortality Rates per 100,000 by Sex in Ohio, 1996-2013**



Source: Chronic Disease Epidemiology and Evaluation Section and the Bureau of Vital Statistics, Ohio Department of Health, 2016.  
CNS = Central Nervous System

Figure 4 shows trends in mortality rates of brain and other CNS cancer in Ohio according to year of death (1996 to 2013) by sex. For each year of comparison, the rate for males was about 40 percent higher than the rate for females. Comparing 1996 to 2013, brain and other CNS cancer mortality rates decreased 12 and 8 percent among males and females, respectively.

## Brain & Other CNS Tumor Incidence by Histology

**Table 3. Brain & Other CNS Tumors: Average Annual Number (N) and Age-adjusted Incidence Rates per 100,000 by Histology and Behavior in Ohio, 2009-2013**

Histology	Malignant		Benign/Borderline	
	Cases	Rate	Cases	Rate
<b>Glioma</b>	739	5.8	34	0.3
<b>Astrocytoma<sup>1</sup></b>	575	4.4	2	0.0
Pilocytic/Diffuse Astrocytoma	98	0.9	0	*
Anaplastic Astrocytoma	45	0.4	0	*
Glioblastoma	428	3.1	<1	*
<b>Oligodendroglioma<sup>2</sup></b>	49	0.4	0	*
<b>Ependymoma<sup>3</sup></b>	27	0.2	22	0.2
<b>Other gliomas</b>	88	0.8	9	0.1
<b>Meningioma</b>	15	0.1	850	6.5
<b>Tumors of Cranial and Spinal Nerves</b>	2	0.0	208	1.7

Source: Ohio Cancer Incidence Surveillance System, Ohio Department of Health, 2016.

<sup>1</sup> Category also includes a small number of unique astrocytoma variants.

<sup>2</sup> Category includes both oligodendroglioma and anaplastic oligodendroglioma.

<sup>3</sup> Category includes both ependymoma and anaplastic ependymoma.

CNS = Central Nervous System

\* Rate not calculated when the case count for 2009-2013 is less than five (i.e., the average count is less than one).

Histology refers to the type of cells making up a tumor. Brain tumors vary considerably by histology and are classified into the following major histologic groupings: 1.) tumors of neuroepithelial tissue (glioma), including astrocytomas, oligodendrogliomas and ependymomas; 2.) tumors of the meninges; and 3.) tumors of the cranial and spinal nerves. Table 3 shows average annual numbers and age-adjusted incidence rates of brain tumors by major histologic grouping and behavior.

### Glioma

In the United States, approximately 75 percent of all primary malignant brain tumors are classified as glioma. Glioma brain tumors arise from glial tissue and represent a large class of tumors with many histologic variations. The three major types of gliomas are astrocytoma, oligodendroglioma and ependymoma.

#### ***Astrocytoma***

Astrocytomas arise from astrocytes primarily in the cerebrum, cerebellum or brain stem and often spread quickly. They are further classified according to grade, which refers to the degree of cellular differentiation. Grade IV astrocytomas, or glioblastomas, are the highest grade (least differentiated) and have exceptionally poor prognoses. Glioblastomas made up almost half of all malignant cases of brain and other CNS cancer diagnosed in Ohio during 2009-2013.

#### ***Oligodendroglioma***

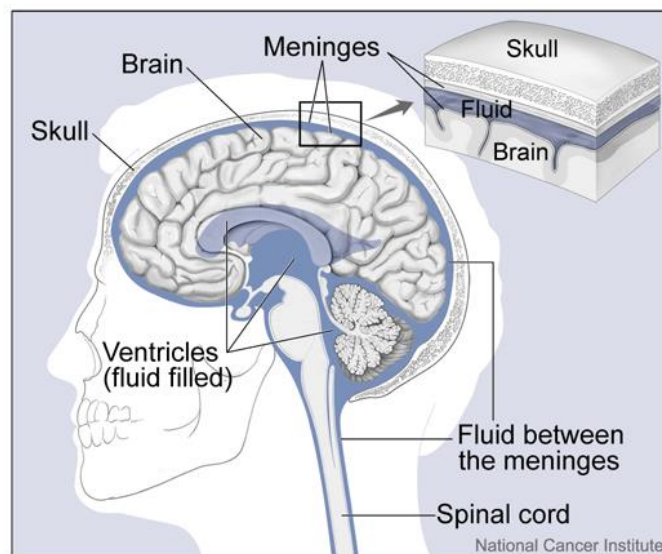
Oligodendrogliomas arise from oligodendrocytes, cells that make the fatty substance that protects the nerves, and usually do not spread into surrounding brain tissue.

#### ***Ependymoma***

Ependymomas, which arise from ependymal cells that line the ventricles (fluid-filled spaces of the brain) or the central canal of the spinal cord, usually do not spread to normal brain tissue and are associated with higher survival probability.

## Meningioma

Meningiomas are tumors of the meninges, the tissue surrounding the brain (See illustration at right). Meningiomas make up a sizable proportion of brain tumors and represent a unique histologic grouping of tumors that are characterized by good prognoses. The vast majority (98 percent) of meningiomas in Ohio are non-malignant. Meningiomas represent the highest number of all new brain and other CNS tumors in Ohio, with an average of 850 benign/borderline cases per year and an age-adjusted incidence rate of 6.5 per 100,000 in 2009-2013. Females in both Ohio and the United States in 2009-2013 had incidence rates of benign meningiomas that were more than double that of males. The reason for this sex difference is not fully understood, but it has been hypothesized that hormones (endogenous and exogenous) may play an etiologic role.



## Tumors of the Cranial and Spinal Nerves

Tumors of the cranial and spinal nerves include nerve sheath tumors and other tumors of the cranial and spinal nerves. These tumors are second to meningioma in the number of benign brain tumors reported in Ohio during 2009-2013.

## Other Tumors in or Near the Brain

Other tumors can start in or near the brain. These include tumors of the sellar region (pituitary gland tumors and craniopharyngiomas), CNS lymphomas and other hemopoietic neoplasms.

### ***Pituitary tumors***

The pituitary gland is a pea-sized organ at the base of the brain. Most pituitary tumors are benign; however, they can cause problems if they press on nearby structures or affect hormone production. In Ohio, pituitary gland tumors accounted for an additional 334 tumors that occurred in or near the brain on average each year during 2009-2013.

### ***Craniopharyngiomas***

Craniopharyngiomas are rare, slow-growing, benign brain tumors that form near the pituitary gland and the hypothalamus. They do not spread to other parts of the brain or to other parts of the body. However, they can grow and press on nearby parts of the brain, including the pituitary gland and the hypothalamus, affecting hormones, or the optic nerves, where they can cause problems with vision. Craniopharyngiomas usually occur in children and young adults. In Ohio, about 14 cases of craniopharyngioma occurred each year during 2009-2013.

### ***CNS Lymphomas***

Lymphomas are cancers that start in cells called lymphocytes (one of the main cell types of the immune system). Most lymphomas start in other parts of the body, but some may start in the CNS. These lymphomas are more common in people with immune system problems, such as those infected with HIV, the virus that causes AIDS. On average, 53 CNS lymphomas were diagnosed each year in Ohio during 2009-2013.



## Brain & Other CNS Tumors in Children and Adolescents by Histology

**Table 4. Brain Tumors: Average Annual Number and Age-adjusted Incidence Rates per 100,000 by Histology and Behavior among Children and Adolescents (Ages 0-19) in Ohio, 2009-2013**

Histology	Malignant		Benign/Borderline	
	Cases	Rate	Cases	Rate
<b>All Childhood &amp; Adolescent Brain &amp; Other CNS</b>	<b>108</b>	<b>3.6</b>	<b>65</b>	<b>2.1</b>
Glioma	82	2.7	9	0.3
Pilocytic Astrocytoma	29	1.0	0	*
Embryonal/Primitive/Medulloblastoma	19	0.6	<1	*
Lipoma	0	*	9	0.3
Blood Vessel Tumors	0	*	7	0.2
Neuroblastoma, including Ganglioma	5	0.2	11	0.4
Meningioma	0	*	5	0.2
Neurofibrosarcoma	0	*	7	0.2
Neurilemoma	0	*	5	0.2

Source: Ohio Cancer Incidence Surveillance System, Ohio Department of Health, 2016.

CNS = Central Nervous System

\* Rate not calculated when the case count for 2009-2013 is less than five (i.e., the average count is less than one).

Brain and other CNS is one of three predominant sites/types of cancer commonly affecting children, adolescents and young adults (ages 0-19 years). The 2009-2013 brain and other CNS cancer incidence rates among those 0-19 in Ohio are shown in Table 4 by behavior and histologic groupings common to children, adolescents and young adults.

In 2009-2013, approximately 62 percent of brain and other CNS tumors in Ohio were malignant. The majority of the malignant tumors were glioma (76 percent); of these, approximately one-third (35 percent) were pilocytic astrocytoma, a lower-grade and usually slow-growing astrocytoma and one of the most common histologic subtypes among children, adolescents and young adults. The non-glioma malignant tumors were comprised of embryonal/primitive/medulloblastoma tumors, which usually develop during childhood from poorly developed 'primitive' cells in the cerebellum area of the brain, and neuroblastoma, including ganglioma, which develop in very early types of nerve cells found in infants and young children.

There were an average of 65 cases of benign/borderline brain and other CNS tumors among children, adolescents and young adults in Ohio in 2009-2013. Of these, the most common histologic grouping was neuroblastoma (including ganglioma), followed by glioma, lipoma (tumors of fatty tissue), and neurofibrosarcoma and neurilemoma, which are both tumors developing in or around peripheral nerves.

Figure 5 presents the 2009-2013 average annual number of cases and age-adjusted incidence rates of glioma (malignant) by county of residence in Ohio. County-specific glioma incidence rates in Ohio ranged from 3.6 to 10.3 per 100,000 in 2009-2013, compared with Ohio's rate of 5.8 per 100,000. The following counties had the highest incidence rates, in decreasing order, for this time period: Gallia, Morgan, Noble, Auglaize and Monroe.

**Rate per 100,000 Persons**

3.6 - 5.1	5.2 - 5.9
6.0 - 6.7	6.8 - 10.3
Suppressed	

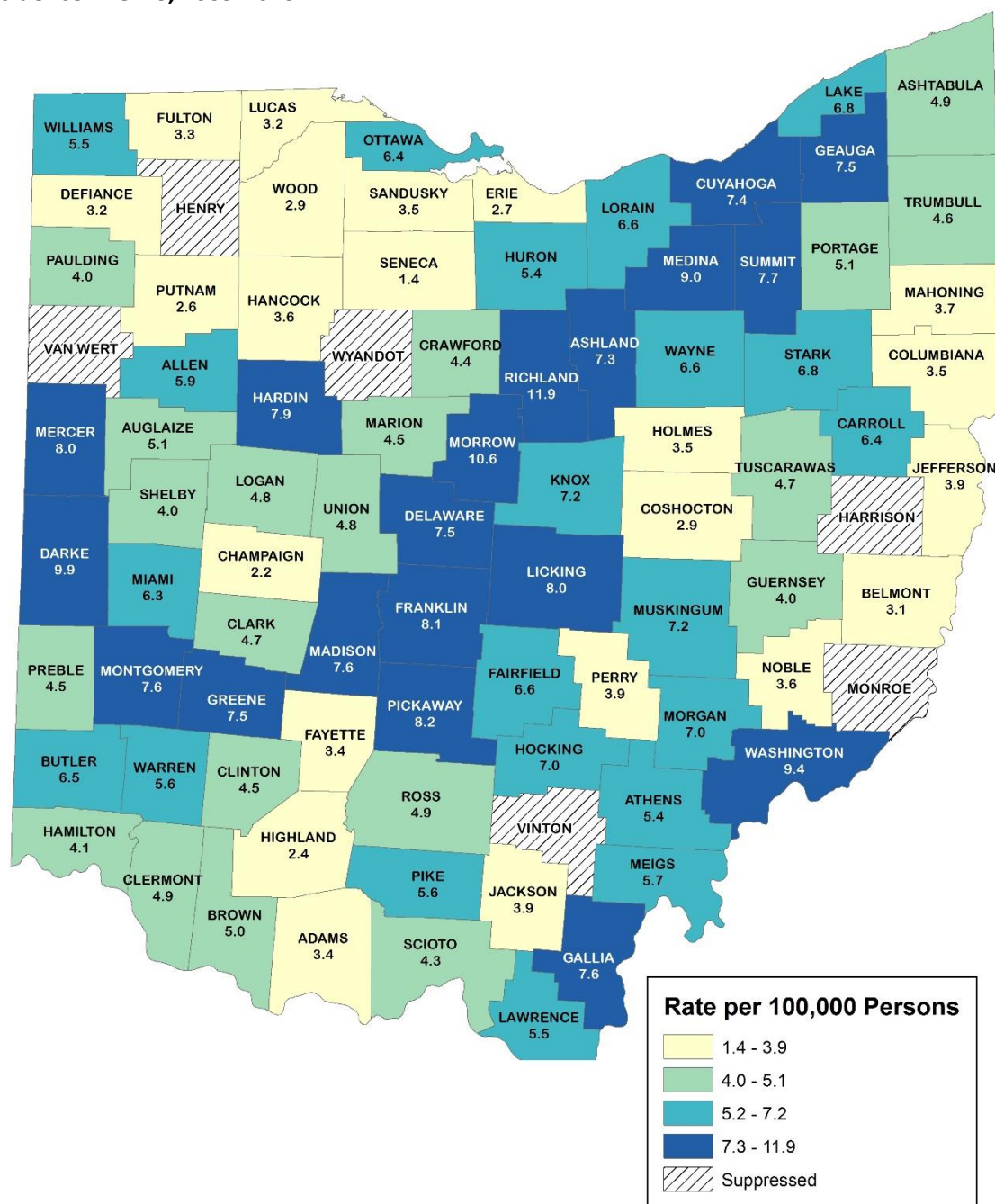
Suppressed = Rate not calculated when the case count for 2009-2013 is less than five (i.e., the average count is less than one).



## Benign Meningioma Incidence by County

Figure 6 shows the average annual number of cases and age-adjusted incidence rates of benign meningioma by county of residence in Ohio in 2009-2013. Benign meningioma incidence rates in Ohio ranged from 1.4 to 11.9 per 100,000, compared with Ohio's rate of 6.1 per 100,000. The following counties had the highest incidence rates, in decreasing order, for this time period: Richland, Morrow, Darke and Washington.

**Figure 6. Benign Meningioma: Average Annual Number of Cases and Age-adjusted Incidence Rates per 100,000 by County of Residence in Ohio, 2009-2013**



Source: Ohio Cancer Incidence Surveillance System, Ohio Department of Health, 2016.

Each category represents approximately 25 percent of the 88 Ohio counties.

Suppressed = Rate not calculated when the case count for 2009-2013 is less than five (i.e., the average count is less than one).

## Risk and Protective Factors

The only well-established potentially modifiable risk factor for brain and other CNS tumors is exposure to ionizing radiation. Most brain and other CNS tumors have no clear known cause.

- **Age:** The risk of meningioma increases steadily with age. The relationship between age and glioma risk varies by tumor histology. Pilocytic astrocytoma typically occurs in children and young adults; oligodendrogliomas are most common in the 35-44 age group; and the incidence of anaplastic astrocytoma and glioblastoma increases with age.
- **Sex:**
  - Gliomas are more common in men than women, with 55 percent of gliomas occurring in men.
  - Meningiomas occur twice as often in women than men; it has been hypothesized that hormones (endogenous and exogenous) may increase risk of meningiomas among women.
  - Medulloblastomas and primitive neuroectodermal tumors are more common in boys than girls.
- **Race and Ethnicity:** In the United States, gliomas are more common in non-Hispanic whites than Hispanics, blacks or Asians. Meningiomas are 20 percent more common in blacks than whites.
- **Exposure to Ionizing Radiation:** People who have been exposed to ionizing radiation, most commonly therapeutic radiation to the head, have an increased risk of developing brain tumors.
- **Genetic Syndromes:** There is an increased risk of brain and other CNS cancer in individuals with specific genetic syndromes including: neurofibromatosis types 1 and 2 (NF1, NF2), tuberous sclerosis, von-Hippel-Lindau disease, Li-Fraumeni syndrome, Gorlin syndrome (basal cell nevus syndrome), Turcot syndrome, Cowden syndrome, hereditary retinoblastoma and Rubinstein-Taybi syndrome.
- **Family History:** There is a small increased risk of brain tumors among relatives of brain tumor patients.
- **Immune System Disorders:** People with impaired immune systems are at increased risk for primary CNS lymphomas.

### Brain and Other CNS Cancer (Tumor) Protective Factors

- **Allergic and Immune-Related Conditions:** There is a reduced risk of glioma for those with allergic or various autoimmune conditions (including asthma, eczema, hay fever). It has been hypothesized that increased immune surveillance in individuals with these conditions results in more effective identification and elimination of precancerous cells.

### Uncertain Risk and Protective Factors

- The following may increase CNS cancer risk: exposure to vinyl chloride, petroleum products or other chemicals, advanced parental age, birth defects, high birth weight, computerized tomography (CT) scans (diagnostic ionizing radiation), maternal dietary NOCs and residential pesticide exposure.
  - There may be a decreased risk for children of mothers who took supplemental folic acid during pregnancy.
-

## Did You Know?

*At present, there is little evidence to suggest a relationship between cell phone use (nonionizing radiation) and brain tumors. The Interphone Study, conducted in 13 countries, found no increase in glioma or meningioma risk associated with the use of cell phones. While cell phone use in the United States has increased significantly from 1992 to 2008, the incidence of glioma has remained relatively stable. More research is needed in this area to determine the effect of long-term cell phone use, as well as allow for a latency period comparable to that observed for ionizing radiation.*

## Signs and Symptoms

Early signs and symptoms of brain and other CNS tumors vary greatly. They may occur gradually and worsen over time, or may occur suddenly. Symptoms result from increased intracranial pressure caused by tumor growth, swelling in the brain or the blocked flow of cerebrospinal fluid. Tumors frequently affect the functions controlled by the area of the brain in which the tumors develop. Signs and symptoms of brain and other CNS tumors include:

- Headaches that increase in number and severity over time
- Nausea
- Vomiting
- Vision problems, including blurred vision, double vision or loss of peripheral vision
- Balance problems
- Personality or behavior changes
- Seizures
- Drowsiness (even coma)
- Weakness or numbness of part of the body
- Problems with speech or understanding words
- Confusion
- Abnormal movements and positioning of the body
- Hearing problems

*Any of these signs/symptoms may be caused by brain and other CNS tumors, or by other, less serious health problems. If you have any of these signs/symptoms, see your healthcare provider.*

## Survival

Survival depends on many factors, including age, tumor type and grade, and where the tumor is located in the CNS. Tumor grade is the description of a tumor based on how abnormal the tumor cells and the tumor tissue look under a microscope and is an indicator of how quickly a tumor is likely to grow and spread. The U.S. (SEER) five-year relative survival probability for brain and other CNS cancer in 2006-2012 was 33.8 percent for males and females combined. Five-year relative survival probability was greater for females (35.1 percent) compared to males (32.8 percent).

Table 5. Brain &amp; Other CNS Cancer: Average Annual Number of New Invasive Cancer Cases and Age-adjusted Incidence Rates per 100,000 by County of Residence and Sex in Ohio, 2009-2013

	Male		Female		Total			Male		Female		Total	
	Cases	Rate	Cases	Rate	Cases	Rate		Cases	Rate	Cases	Rate	Cases	Rate
<b>Ohio</b>	<b>490</b>	<b>8.2</b>	<b>389</b>	<b>5.7</b>	<b>879</b>	<b>6.9</b>	Lawrence	2	5.3	1	4.3	3	4.8
<b>U.S.</b>	<b>7.6</b>	<b>5.4</b>	<b>6.4</b>				Licking	8	10.0	5	6.0	13	7.9
Adams	2	10.7	1	7.4	3	8.8	Logan	3	11.1	<1	*	4	6.9
Allen	4	6.5	4	6.2	7	6.3	Lorain	13	8.0	11	6.1	24	6.9
Ashland	2	5.5	2	5.6	4	5.6	Lucas	15	6.8	13	5.4	29	6.1
Ashtabula	4	8.1	4	7.4	9	7.7	Madison	1	6.2	1	6.5	3	6.2
Athens	2	7.5	2	5.5	3	6.4	Mahoning	12	9.3	7	4.1	20	6.5
Auglaize	3	10.9	2	7.7	5	9.3	Marion	3	7.3	3	7.5	5	7.5
Belmont	3	7.1	3	5.9	5	6.3	Medina	9	9.0	7	6.9	15	7.8
Brown	2	9.5	<1	*	3	6.1	Meigs	1	7.1	<1	*	2	6.0
Butler	14	8.2	13	6.0	27	7.1	Mercer	2	9.2	2	6.5	4	8.0
Carroll	2	11.3	1	6.9	3	8.5	Miami	5	9.4	4	5.3	8	7.3
Champaign	2	8.5	2	9.2	4	8.8	Monroe	1	8.7	1	12.9	2	10.9
Clark	5	6.7	5	6.3	10	6.5	Montgomery	21	7.5	15	4.9	36	6.0
Clermont	9	8.8	6	5.4	15	7.1	Morgan	1	15.7	<1	*	2	11.3
Clinton	2	7.8	1	5.1	3	6.4	Morrow	1	4.7	1	6.1	2	5.5
Columbiana	6	10.2	3	4.8	9	7.4	Muskingum	4	8.3	3	5.7	7	6.9
Coshocton	3	14.4	1	6.2	4	9.8	Noble	1	14.5	<1	*	1	9.2
Crawford	1	3.9	2	8.6	3	6.4	Ottawa	2	6.2	2	5.0	3	5.9
Cuyahoga	55	8.4	46	5.6	101	6.9	Paulding	1	8.5	<1	*	2	7.4
Darke	3	10.3	2	5.9	5	7.9	Perry	2	9.8	2	8.4	3	8.6
Defiance	1	5.7	2	6.4	3	5.8	Pickaway	2	5.1	1	4.8	3	5.0
Delaware	6	6.7	6	7.3	12	7.1	Pike	<1	*	1	5.1	2	4.2
Erie	4	7.2	2	5.2	6	6.1	Portage	9	11.6	6	6.9	15	9.1
Fairfield	7	9.5	5	5.8	12	7.8	Preble	2	8.0	1	5.6	3	6.6
Fayette	1	8.6	1	5.8	3	7.6	Putnam	2	12.7	<1	*	3	8.0
Franklin	42	8.1	34	5.7	77	6.8	Richland	5	7.1	3	4.1	8	5.5
Fulton	2	10.2	1	5.1	4	7.8	Ross	3	7.8	3	6.6	6	7.4
Gallia	3	17.8	1	6.7	4	12.0	Sandusky	2	5.5	2	4.4	3	4.8
Geauga	6	10.6	2	3.6	8	6.9	Scioto	4	9.1	2	5.0	6	7.1
Greene	6	7.0	5	5.1	10	6.0	Seneca	2	7.1	2	4.4	4	5.9
Guernsey	<1	*	1	4.7	2	4.7	Shelby	3	13.7	2	5.9	5	9.6
Hamilton	29	7.8	29	6.1	58	6.9	Stark	14	6.5	13	5.4	27	6.0
Hancock	4	10.6	2	3.5	6	7.0	Summit	23	8.3	22	7.0	46	7.5
Hardin	1	7.6	<1	*	2	5.2	Trumbull	11	9.7	8	6.1	19	7.8
Harrison	<1	*	<1	*	<1	*	Tuscarawas	5	10.2	2	4.3	7	7.1
Henry	1	6.8	1	7.3	2	7.2	Union	3	13.3	<1	*	4	8.0
Highland	1	6.9	2	6.3	3	6.5	Van Wert	<1	*	<1	*	1	3.5
Hocking	1	9.8	<1	*	2	6.3	Vinton	<1	*	<1	*	<1	*
Holmes	2	6.9	2	8.7	4	7.9	Warren	9	7.8	6	5.4	15	6.5
Huron	2	7.6	3	8.8	5	8.4	Washington	3	8.4	2	6.7	5	7.5
Jackson	2	9.3	1	6.6	3	8.1	Wayne	6	9.9	5	8.1	11	8.9
Jefferson	3	7.2	3	6.7	6	6.8	Williams	1	7.8	2	7.1	3	7.4
Knox	3	7.8	2	4.7	5	6.3	Wood	6	9.8	3	4.0	9	6.7
Lake	13	9.8	9	6.5	21	7.9	Wyandot	1	8.3	<1	*	1	4.7

Source: Ohio Cancer Incidence Surveillance System, Ohio Department of Health, 2016; Surveillance, Epidemiology and End Results (SEER) Program, National Cancer Institute, 2016.

\*Rate not presented when the count for 2009-2013 is less than five (i.e., the average annual count is less than one).

CNS = Central Nervous System

Table 6. Brain &amp; Other CNS Cancer: Average Annual Number of Cancer Deaths and Age-adjusted Mortality Rates per 100,000 by County of Residence and Sex in Ohio, 2009-2013

	Male		Female		Total			Male		Female		Total	
	Deaths	Rate	Deaths	Rate	Deaths	Rate		Deaths	Rate	Deaths	Rate	Deaths	Rate
<b>Ohio</b>	<b>329</b>	<b>5.4</b>	<b>260</b>	<b>3.6</b>	<b>589</b>	<b>4.4</b>	Lawrence	2	5.1	1	2.4	3	3.6
<b>U.S.</b>	<b>5.3</b>		<b>3.5</b>		<b>4.3</b>		Licking	6	7.4	5	4.4	11	5.8
Adams	2	11.1	<1	*	2	7.1	Logan	2	6.1	<1	*	2	3.8
Allen	2	4.1	2	3.3	5	3.7	Lorain	12	7.0	8	4.3	20	5.5
Ashland	1	3.7	1	2.3	2	3.1	Lucas	13	5.8	11	3.8	24	4.8
Ashtabula	2	3.8	3	5.2	5	4.6	Madison	<1	*	<1	*	2	3.6
Athens	1	4.2	2	5.6	3	4.7	Mahoning	9	6.1	7	3.3	15	4.7
Auglaize	2	7.8	2	6.5	4	7.3	Marion	1	3.8	2	6.2	4	5.0
Belmont	2	4.8	2	5.0	4	4.8	Medina	5	5.3	5	4.3	10	4.7
Brown	1	4.8	2	7.3	3	5.9	Meigs	<1	*	<1	*	1	4.9
Butler	9	5.0	9	4.2	18	4.6	Mercer	1	5.3	2	9.0	4	7.3
Carroll	2	8.8	1	5.8	3	6.7	Miami	2	4.2	3	3.6	5	4.0
Champaign	2	6.4	<1	*	2	4.7	Monroe	<1	*	<1	*	<1	*
Clark	3	3.8	3	3.5	6	3.7	Montgomery	14	4.8	8	2.4	22	3.4
Clermont	5	5.0	3	2.8	8	3.8	Morgan	<1	*	<1	*	1	6.6
Clinton	<1	*	<1	*	1	2.4	Morrow	2	7.4	<1	*	2	5.2
Columbiana	4	6.2	2	3.0	7	4.5	Muskingum	3	6.4	2	3.7	5	5.0
Coshocton	2	7.2	2	7.9	3	7.6	Noble	<1	*	<1	*	<1	*
Crawford	1	3.9	1	2.8	2	3.4	Ottawa	1	5.4	1	3.8	2	4.7
Cuyahoga	34	5.0	30	3.4	64	4.1	Paulding	<1	*	1	9.2	2	8.4
Darke	2	5.0	1	3.7	3	4.4	Perry	1	5.7	<1	*	2	4.3
Defiance	1	5.4	<1	*	2	3.8	Pickaway	<1	*	<1	*	1	1.5
Delaware	3	3.9	3	4.1	7	4.1	Pike	<1	*	<1	*	1	3.5
Erie	4	8.6	3	5.2	7	6.8	Portage	7	8.5	2	2.8	9	5.5
Fairfield	4	5.3	4	3.8	7	4.4	Preble	2	6.4	2	6.0	3	6.1
Fayette	1	7.0	<1	*	2	4.8	Putnam	1	6.5	<1	*	2	4.2
Franklin	28	5.7	17	2.9	45	4.1	Richland	4	5.6	3	4.6	8	4.9
Fulton	1	5.7	2	7.5	3	6.7	Ross	2	4.9	2	4.6	4	4.8
Gallia	2	9.2	<1	*	2	6.2	Sandusky	2	4.6	2	5.2	3	4.6
Geauga	3	5.2	2	3.0	5	4.1	Scioto	3	7.0	2	4.5	5	5.8
Greene	4	5.1	3	2.5	7	3.7	Seneca	1	3.8	<1	*	2	3.0
Guernsey	1	4.8	1	4.6	3	4.9	Shelby	1	5.7	<1	*	2	3.7
Hamilton	15	4.0	14	2.8	29	3.4	Stark	10	5.1	10	3.8	20	4.5
Hancock	3	7.4	1	2.7	4	5.0	Summit	16	5.8	15	4.5	32	5.0
Hardin	<1	*	<1	*	1	2.7	Trumbull	8	6.8	4	3.2	12	4.9
Harrison	<1	*	<1	*	<1	*	Tuscarawas	4	7.9	2	3.0	6	5.5
Henry	<1	*	1	5.2	1	3.8	Union	1	5.5	<1	*	2	4.1
Highland	2	7.6	<1	*	2	3.8	Van Wert	<1	*	1	4.9	1	3.6
Hocking	<1	*	1	5.7	2	4.8	Vinton	<1	*	<1	*	<1	*
Holmes	<1	*	<1	*	1	2.7	Warren	4	4.2	4	3.4	9	3.8
Huron	3	8.5	2	4.2	4	6.5	Washington	3	7.6	2	4.8	5	6.1
Jackson	1	5.1	1	5.7	2	5.6	Wayne	4	6.6	4	6.1	8	6.2
Jefferson	2	3.7	1	2.3	3	2.9	Williams	<1	*	2	8.7	3	6.6
Knox	2	4.6	2	3.9	3	4.3	Wood	4	6.2	3	3.8	7	4.9
Lake	11	7.8	6	3.5	16	5.5	Wyandot	<1	*	<1	*	1	3.9

Source: Chronic Disease Epidemiology and Evaluation Section and the Bureau of Vital Statistics, Ohio Department of Health, 2016. Surveillance, Epidemiology and End Results (SEER) Program, National Cancer Institute, 2016.

\*Rate not presented when the count for 2009-2013 is less than five (i.e., the average annual count is less than one).

CNS = Central Nervous System

## Technical Notes

**Age-Adjusted Rate:** A summary rate that is a weighted average of age-specific rates, where the weights represent the age distribution of a standard population (direct adjustment). The incidence and mortality rates presented in this report were standardized to the age distribution of the 2000 U.S. Standard Population. Under the direct method, the population was first divided into 19 five-year age groups, i.e., <1, 1-4, 5-9, 10-14, 15-19...85+, and the age-specific rate was calculated for each age group. Each age-specific rate was then multiplied by the standard population proportion for the respective age group.

**Average Annual Number (N):** The number of cases or deaths diagnosed per year, on average, for the time period of interest (e.g., 2009-2013). Average annual numbers are calculated by summing the number of cases or deaths for a given time period, dividing by the number of years that comprise the time period and rounding to the nearest whole number.

**Census Data:** The 1996-2013 rates were calculated using population estimates from the U.S. Census Bureau and National Center for Health Statistics. Population data were compiled from bridged-race intercensal population estimates for July 1, 1990-July 1, 1999; revised bridged-race intercensal population estimates for July 1, 2000-July 1, 2004 (released 10/26/2012); revised bridged-race intercensal population estimates for July 1, 2005-July 1, 2009 (released 6/26/2014) and vintage 2015 bridged-race postcensal population estimates for July 1, 2010-July 1, 2015 (released 6/28/2016).

**Incidence:** The number of cases diagnosed during a specified time period (e.g., 2009-2013). Brain and other CNS cancer cases were defined as follows: International Classification of Diseases for Oncology, Third Edition (ICD-O-3), codes C700-C729.

**Invasive Cancer:** A malignant tumor that has infiltrated the organ in which the tumor originated. Invasive cancers consist of those diagnosed at the local, regional, distant and unstaged/missing stages.

**Mortality:** The number of deaths during a specified time period (e.g., 2009-2013). Brain and other CNS cancer deaths were defined as follows: International Statistical Classification of Diseases and Related Health Problems, Tenth Edition (ICD-10), codes C700-C729.

**Rate:** The number of cases or deaths per unit of population (e.g., per 100,000 persons) during a specified time period (e.g., 2009-2013). Rates may be unstable and are not presented when the count is less than five.

**Stage at Diagnosis:** The degree to which a tumor has spread from its site of origin at the time of diagnosis. Cancer stage is often related to survival and is used to select appropriate treatment. Patients with early stage disease often have better long-term survival, and detecting cancers at an early stage may lead to a reduction in mortality. The stages of cancer, in the order of increasing spread, are *in situ*, local, regional and distant. *In situ* and localized tumors are referred to as early stage tumors, and regional and distant tumors are termed late stage. Cancers diagnosed at the local, regional, distant and unstaged/missing stages are categorized as invasive.

***in situ***—Noninvasive cancer that has not penetrated surrounding tissue.

**Local**—A malignant tumor confined entirely to the organ of origin.

**Regional**—A malignant tumor that has extended beyond the organ of origin directly into surrounding organs or tissues or into regional lymph nodes.

**Distant**—A malignant tumor that has spread to parts of the body (distant organs, tissues and/or lymph nodes) remote from the primary tumor.

**Unstaged/Missing**—Insufficient information is available to determine the stage or extent of the disease at diagnosis.

**Survival Probability:** The probability that an individual will survive a given number of years after diagnosis. Five-year relative survival probabilities are from the SEER Program 18 areas for diagnosis years 2006-2012.

---



## Sources of Data and Additional Information

**Ohio Department of Health Cancer Data and Statistics:**

<http://www.odh.ohio.gov/health/cancer/ocisshs/newrpts1.aspx>

**National Cancer Institute:**

<https://www.cancer.gov/types/brain>

<https://www.cancer.gov/types/brain/hp>

**American Cancer Society:**

<https://www.cancer.org/cancer/brain-spinal-cord-tumors-adults.html>

<https://www.cancer.org/cancer/brain-spinal-cord-tumors-children.html>

**To address comments and information requests:**

Ohio Cancer Incidence Surveillance System (OCISS)

Ohio Department of Health

246 North High Street

Columbus, OH 43215

Phone: (614) 752-2689

Fax: (614) 644-8028

E-mail: [ociss@odh.ohio.gov](mailto:ociss@odh.ohio.gov)

OCISS website: [http://www.odh.ohio.gov/health/cancer/ocisshs/ci\\_surv1.aspx](http://www.odh.ohio.gov/health/cancer/ocisshs/ci_surv1.aspx)

## Acknowledgements

**Ohio Department of Health**

Holly L. Sobotka, MS

John Kollman, MS

Emily Bunt, MA

**The Ohio State University**

James L. Fisher, PhD

Julie A. Stephens, MS

Ryan D. Baltic, MPH

Sincere appreciation to the OCISS, cancer registrars, medical records technicians and other health professionals who improve the collection and quality of cancer data in Ohio.

## Suggested Citation

*Brain and Other Central Nervous System Tumors in Ohio, 2009-2013.* Ohio Cancer Incidence Surveillance System, Ohio Department of Health, April 2017.

This report is public information. Reproduction and copying of this report for cancer prevention and control, education and program planning are greatly encouraged. Citation of source, however, is appreciated.



The OCISS is supported in part by the State of Ohio and the Centers for Disease Control and Prevention (CDC), National Program of Cancer Registries, cooperative agreement number 6NU58DP003936. The contents are the sole responsibility of the authors and do not necessarily represent the official views of the CDC.