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CBTRUS Statistical Report: Primary Brain and Other Central Nervous System Tumors Diagnosed in the United States in 2012–2016

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Abstract

The Central Brain Tumor Registry of the United States (CBTRUS), in collaboration with the Centers for Disease Control and Prevention and National Cancer Institute, is the largest population-based registry focused exclusively on primary brain and other central nervous system (CNS) tumors in the United States (US) and represents the entire US population. This report contains the most up-to-date population-based data on primary brain tumors available and supersedes all previous reports in terms of completeness and accuracy. All rates are age-adjusted using the 2000 US standard population and presented per 100,000 population. The average annual age-adjusted incidence rate (AAAIR) of all malignant and non-malignant brain and other CNS tumors was 23.41 (Malignant AAAIR = 7.08, non-Malignant AAAIR = 16.33). This rate was higher in females compared to males (25.84 versus 20.82), Whites compared to Blacks (23.50 versus 23.34), and non-Hispanics compared to Hispanics (23.84 versus 21.28). The most commonly occurring malignant brain and other CNS tumor was glioblastoma (14.6% of all tumors), and the most common non-malignant tumor was meningioma (37.6% of all tumors). Glioblastoma was more common in males, and meningioma was more common in females. In children and adolescents (age 0–19 years), the incidence rate of all primary brain and other CNS tumors was 6.06. An estimated 86,010 new cases of malignant and non-malignant brain and other CNS tumors are expected to be diagnosed in the US in 2019 (25,510 malignant and 60,490 non-malignant). There were 79,718 deaths attributed to **malignant** brain and other CNS tumors between 2012 and 2016. This represents an average annual mortality rate of 4.42. The five-year relative survival rate following diagnosis of a **malignant** brain and other CNS tumor was 35.8%, and the five-year relative survival rate following diagnosis of a **non-malignant** brain and other CNS tumors was 91.5%.

Executive Summary

The Central Brain Tumor Registry of the United States (CBTRUS), in collaboration with the Centers for Disease Control and Prevention (CDC) and National Cancer Institute (NCI), is the largest population-based registry focused exclusively on primary brain and other central nervous system (CNS) tumors in the United States (US) and represents the entire US population. The *CBTRUS Statistical Report: Primary Brain and Other Central Nervous System Tumors Diagnosed in the United States in 2012–2016* contains the most up-to-date

population-based data on primary brain tumors available through the surveillance system in the US and supersedes all previous reports in terms of completeness and accuracy, thereby providing a current comprehensive source for the descriptive epidemiology of these tumors. All rates are age-adjusted using the 2000 US standard population and presented per 100,000 population.

Incidence

- **The average annual age-adjusted incidence rate of all malignant and non-malignant brain and other CNS tumors was 23.41 per 100,000 between 2012 and 2016.** This rate was higher in females compared to males (25.84 versus 20.82 per 100,000), Whites compared to Blacks (23.50 versus 23.34 per 100,000), and non-Hispanics (of any race) compared to Hispanics (23.84 versus 21.28 per 100,000).
- The average annual age-adjusted incidence rate of **malignant** brain and other CNS tumors was 7.08 per 100,000.
- The average annual age-adjusted incidence rate of **non-malignant** brain and other CNS tumors was 16.33 per 100,000.
- Approximately 30.2% of all brain and other CNS tumors were **malignant** and 69.8% were **non-malignant**, which makes **non-malignant tumors more than twice as common as malignant tumors**.
- The most commonly occurring **malignant** brain and other CNS tumor was glioblastoma (14.6% of **all tumors** and 48.3% of **malignant** tumors), and the most common **non-malignant** tumor was meningioma (37.6% of **all tumors** and 53.3% of **non-malignant** tumors). Glioblastoma was more common in males, and meningioma was more common in females.
- In children and adolescents (age 0–19 years), the incidence rate of **malignant** and **non–malignant** brain and other CNS tumors was 6.06 per 100,000 between 2012 and 2016. Incidence was higher in females compared to males (6.13 versus 5.98 per 100,000), Whites compared to Blacks (6.29 versus 4.71 per 100,000), and non-Hispanics compared to Hispanics (6.35 versus 5.14 per 100,000).
- An estimated 86,010 new cases of **malignant** and **non-malignant** brain and other CNS tumors are expected to be diagnosed in the US in 2019. This includes an expected 25,510 **malignant** and 60,490 **non-malignant** tumors.

Mortality

- There were 79,718 deaths attributed to **malignant** brain and other CNS tumors between 2012 and 2016. This represents an average annual mortality rate of 4.42 per 100,000, and an average of 15,944 deaths per year caused by **malignant** brain and other CNS tumors.

Survival

- The five-year relative survival rate following diagnosis of a **malignant** brain and other CNS tumor was 35.8%. Five-year relative survival was lowest for glioblastoma (6.8%). Survival following diagnosis with a **malignant** brain and other CNS tumor was highest in persons age 0–14 years (74.7%), compared to those ages 15–39 years (71.3%) or 40+ years (21.3%).
- The five-year relative survival rate following diagnosis of a **non-malignant** brain and other CNS tumor was 91.5%. Five-year relative survival was highest for nerve sheath tumors (99.3%) and lowest for primary melanocytic lesions (63.3%) and craniopharyngioma (86.1%). Survival following diagnosis with a **non-malignant** brain and other CNS tumor was highest in persons age 15–39 years (98.1%), compared to those ages 0–14 years (97.2%) or 40+ years (90.1%).

Introduction

The objective of the *CBTRUS Statistical Report: Primary Brain and Other Central Nervous System Tumors Diagnosed in the United States in 2012–2016* is to provide a comprehensive summary of the current descriptive epidemiology of primary brain and other central nervous system (CNS) tumors in the United States (US) population. CBTRUS obtained the latest available population-based data on all newly diagnosed primary brain and CNS tumors from the CDC's National Program of Cancer Registries (NPCR), and the NCI's Surveillance, Epidemiology, and End Results (SEER) program for diagnosis years 2012–2016. Incidence counts and rates of primary malignant and non-malignant brain and other CNS tumors are presented by histology, sex, age, race, and Hispanic ethnicity. Mortality rates calculated using the National Vital Statistics System (NVSS) data from 2012–2016, and relative survival rates for selected malignant and non-malignant histologies calculated using NPCR data for the period 2001–2015, are also presented.

Background

CBTRUS is a unique professional research organization that focuses exclusively on providing high-quality statistical data on the population-based incidence of primary brain and other CNS tumors in the US (for more information on CBTRUS see: http://www.cbtrus.org/aboutus.html).[1] CBTRUS was incorporated as a nonprofit 501(c)(3) in 1992 following a study conducted by the American Brain Tumor Association (ABTA) to determine the feasibility of a central registry focused on primary brain and other CNS tumors in the US.

This report represents the twenty-seventh (27th) anniversary of CBTRUS and the twenty-second (22nd) statistical report published by CBTRUS. For this eighth (8th) report published as a supplement to *Neuro-Oncology*, the official journal of the Society for Neuro-Oncology (http://www.soc-neuro-onc.org), CBTRUS continues its past efforts to provide the most up-to-date population-based incidence rates for all primary brain and other CNS tumors by behavior (malignant, non-malignant), histology, age, sex, race, and Hispanic ethnicity. These data have been organized by clinically relevant histology groupings and reflect the *2007 World Health Organization (WHO) Classification of Tumours of the Central Nervous System*.[2,3] The 2007 WHO Classification has not been fully implemented into US collection practices and histologies with new codes included

in 2007 are recoded to existing ICD-0-3 codes and included in cancer registration reports. These data provide important information for allocation and planning of specialty healthcare services such as clinical trials, disease prevention and control programs, and research activities. These data may also lead to clues that will stimulate research into the causes of this group of diseases, which often result in significant morbidity and mortality.

CBTRUS is currently the only population-based site-specific registry in the US that works in partnership with a public cancer surveillance organization, the CDC's NPCR, and from which data are directly received through the NPCR Cancer Surveillance System (NPCR-CSS) Submission Specifications mechanism[4] under a special agreement. Collection of central (state) cancer data was mandated in 1992 by Public Law 102–515, the Cancer Registries Amendment Act.[5] This mandate was expanded to include non-malignant CNS tumors with the 2002 passage of Public Law 107–260, starting January 1, 2004.[6] CBTRUS combines the NPCR data with data from the NCI's SEER program,[7] which was established for national cancer surveillance in the early 1970s. All data from NPCR and SEER originate from tumor registrars who adhere to the Uniform Data Standards (UDS) for malignant and non-malignant brain and other CNS tumors as directed by the North American Association of Cancer Registries (NAACCR) (http://www.naaccr.org). Along with the UDS, there are quality control checks and a system for rating each central cancer registry (CCR) to ensure that these data are as accurate and complete as possible. As a surveillance partner, CBTRUS reports high-quality data on a all primary brain and other CNS tumors with histological specificity useful to the communities it serves.

The CBTRUS database is comprised of the largest histology-specific aggregation of population-based data limited to the incidence of primary brain and other CNS tumors in the US, and it is likely the largest histology-specific aggregation of primary brain and other CNS tumor cases in the world. There are several other brain-specific registry systems in existence, including the Austrian Brain Tumor Registry[8] and the Swedish Brain Tumor Registry,[9] as well as other population-based epidemiological studies of primary brain and other CNS tumors that cover a smaller population base. Due to the demographics of the US as compared to European countries, CBTRUS includes increased numbers of cases of primary brain and other CNS tumors in non-White persons. Aggregate information on all cancers from all CCR in the US, including primary brain and other CNS tumors, is available from the *United States Cancer Statistics (USCS)*.[10]

Technical Notes

Data Collection

CBTRUS does not collect data directly from patients' medical records. Registration of individual cases (tumors) is conducted by cancer registrars at the institution where diagnosis and/or treatment occurs and is then transmitted to the CCR, which further transmits this information to NPCR. Some CCR also send their data to SEER. As noted, data for CBTRUS analyses come from the NPCR and SEER programs. By law, all primary malignant and non-malignant CNS tumors are reportable diseases and CCR play an essential role in the collection process. Tumor registrars in treatment centers collect these data and send this information to the CCR in their state where they are collated, de-identified, and sent to NPCR and SEER. Primary brain and other CNS tumors are reported using the site definition described in Public Law 107–260.[6] These data are population-based and represent a comprehensive documentation of all reported cancers diagnosed within a geographic region for the years included in this report.

CBTRUS obtained incidence data from 52 CCR (47 NPCR and 5 SEER) that include cases of malignant and non-malignant (benign and uncertain behaviors) primary brain and other CNS tumors. The population-based CCR include 50 state registries, the District of Columbia, and Puerto Rico (Fig. 1A). **Data were requested for all newly-diagnosed primary malignant and non-malignant tumors from 2012 to 2016 at any of the following International Classification of Diseases for Oncology, 3rd Edition (ICD-O-3) anatomic sites: brain, meninges, spinal cord, cranial nerves, and other parts of the central nervous system, pituitary and pineal glands, and olfactory tumors of the nasal cavity** (Table 1).[11]

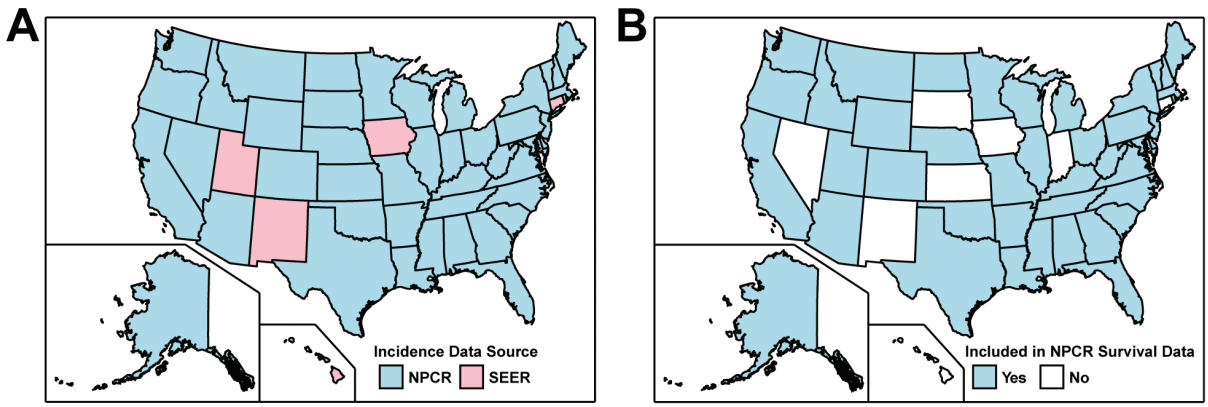
NPCR provided data on 401,606 primary brain and other CNS tumors diagnosed from 2012 to 2016 (Fig. 2). An additional 17,254 primary brain and CNS tumor case records for the period were obtained from SEER. These data were combined into a single dataset of 418,860 records for quality control as part of the CBTRUS Edits program. A total of 10,727 records (2.6%) were deleted from the final analytic dataset for one or more of the following reasons (Fig. 2):

- Records with ICD-O behavior code of 2.
- Records with invalid site/histology combination according to the CBTRUS histology grouping scheme
- Possible duplicate records that included a less accurate reporting source than microscopic confirmation, also referred to as histologic confirmation (eg, radiographic versus microscopic confirmation), possible duplicate record for recurrent disease, or errors in time sequence of diagnosis
- Possible duplicate records for bilateral vestibular schwannoma or meningioma that were merged to one paired-site record.

The final analytic dataset had 408,133 records, which included 405,740 records from the 50 state CCR and the District of Columbia used in the analytic dataset, and an additional 2,393 records from Puerto Rico. **Records from Puerto Rico were included only in a supplementary analysis, and these cases are not included in the overall statistics presented in this report.**

Age-adjusted incidence rates per 100,000 population for the entire US for selected other cancers were obtained from the United States Cancer Statistics (USCS), produced by the CDC and the NCI, for the purpose of comparison with brain and other CNS tumor incidence rates.[10] This database includes both NPCR and SEER data and represents the entire US population.

As of the 2019 annual report, CBTRUS now presents survival statistics based on the NPCR's USCS survival data (Fig. 1B). Survival data for malignant brain and other CNS tumors were obtained from the USCS program for 43 NPCR

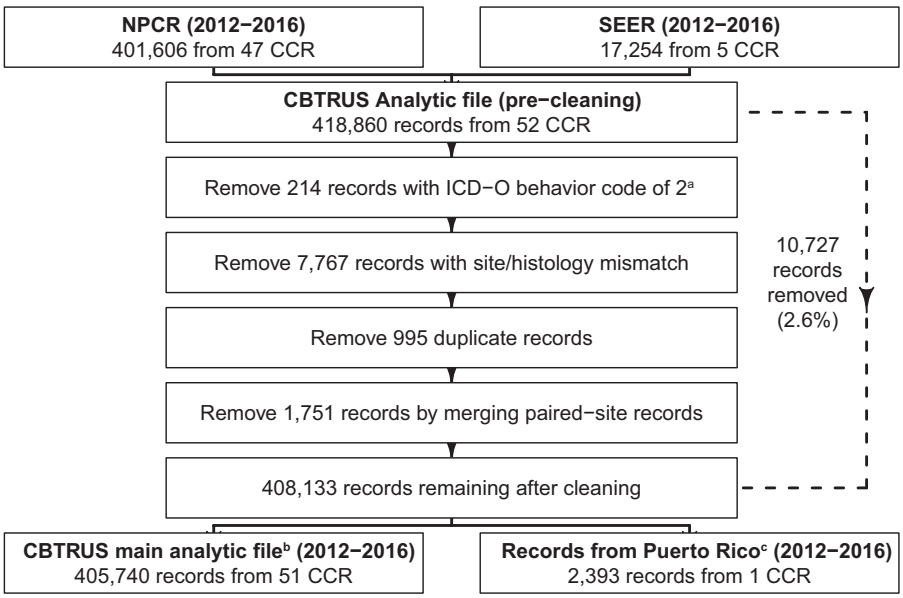


Alabama	Hawaii[SEER]	Michigan	North Carolina	Texas
Alaska	Idaho	Minnesota	North Dakota	Utah[SEER]
Arizona	Illinois	Mississippi	Ohio	Vermont
Arkansas	Indiana	Missouri	Oklahoma	Virginia
California	Iowa[SEER]	Montana	Oregon	Washington
Colorado	Kansas	Nebraska	Puerto Rico	West Virginia
Connecticut[SEER]	Kentucky	Nevada	Pennsylvania	Wisconsin
Delaware	Louisiana	New Hampshire	Rhode Island	Wyoming
District of Columbia	Maine	New Jersey	South Carolina	
Florida	Maryland	New Mexico[SEER]	South Dakota	
Georgia	Massachusetts	New York	Tennessee	

Alabama	Illinois	Nebraska	South Carolina
Alaska	Indiana	New Hampshire	Tennessee
Arizona	Kansas	New Jersey	Texas
Arkansas	Kentucky	New York	Utah
California	Louisiana	North Carolina	Vermont
Colorado	Maine	North Dakota	Washington
Delaware	Maryland	Ohio	West Virginia
District of Columbia	Minnesota	Oklahoma	Wisconsin
Florida	Mississippi	Oregon	Wyoming
Georgia	Missouri	Pennsylvania	
Idaho	Montana	Rhode Island	

[SEER] Data obtained from the SEER research data files for these population-based central cancer registries (CCR) for incidence calculations. Data from all other population-based CCR provided by the NPCR, which may include registries for which data are also available through SEER.

Fig. 1 Availability by Central Cancer Registry for A) SEER and NPCR Incidence Data (2000–2016) and B) NPCR Survival Data (2001–2015)



a. ICD–O–3 behavior code of 2 is used to designate in situ cases, which is not a relevant classification for brain and other CNS tumors.
b. Records from 50 state CCR and Washington, DC are used for all tables and figures presented in this report unless otherwise specificed.
c. Data from Puerto Rico is presented in Supplementary Figure 14 only.
Abbreviations: CBTRUS=Central Brain Tumor Registry of the United States; CCR=Central Cancer Registry; NPCR=National Program of Cancer Registries; SEER=Surveillience, Epidemiology, and End Results

Fig. 2 Overview of CBTRUS Data Edits Workflow

registries for the years 2001 to 2015, and for non-malignant brain and other CNS tumors for the years 2004 to 2015. This dataset provides population-based information for approximately 93% of the US population for the years 2001 to 2015, and is a subset of the data used for the incidence calculations presented in this report. Survival information is derived from both active and passive follow-up.

Mortality data used in this report are from the National Center for Health Statistics (NCHS) and include deaths where primary brain or other CNS tumor was listed as

cause of death on the death certificate for individuals from all 50 states and the District of Columbia. These data were obtained from the National Vital Statistics System (NVSS)[12] (includes death certification data for 100% of the US population) for malignant brain and other CNS tumors and comparison via SEER*Stat (for malignant brain tumors and comparison cancers). NVSS data are not collected through the cancer registration system, and therefore these data are not included under cancer registration mandates. These data represent the primary cause of death listed on each individual death certificate, and as a result, deaths in persons with cancer may be recorded as non-cancer deaths.

Definitions

Measures in surveillance epidemiology

The CBTRUS Report presents the following population-based measures: incidence rates, mortality rates, and relative survival rates (for more information on definitions of terms and measures used see: http://www.cbtrus.org/glossary/glossary1.html).

Classification by behavior, histology, and WHO grade

There are over 100 histologically distinct types of primary CNS tumors, each with its own spectrum of clinical presentations, treatments, and outcomes. This report uses the most recent 2012 CBTRUS Histology Grouping (Table 2). This classification scheme utilizes ICD-O-3 codes[11] and may include morphology codes that were not previously reported to CBTRUS.[13] In this report, incidence rates are provided for major histology groupings and for specific histologies.

Gliomas are tumors that arise from glial or precursor cells and include astrocytoma (including glioblastoma), oligodendroglioma, ependymoma, oligoastrocytoma (mixed glioma), malignant glioma, not otherwise specified (NOS), and a few rare histologies. Because there is no standard definition for glioma, **CBTRUS defines glioma as ICD-O-3 histology codes 9380–9384, and 9391–9460 in accordance with the recode rules for 2007 WHO Classification of CNS tumors as starred in** Table 2. It is also important to note that the statistics for lymphomas and hematopoietic neoplasms contained in this report refer only to those lymphomas and hematopoietic neoplasms that arise in the brain and other CNS ICD-O-3 topography codes.

This report also utilizes the International Classification of Childhood Cancer (ICCC) grouping system for pediatric cancers. ICCC categories for this report were generated using the SEER Site/Histology ICCC-3 Recode[14] based on the ICCC, Third edition[15] and 2007 WHO Classification of Tumours of Haematopoietic and Lymphoid Tissues[16] (See Supplementary Table 1 for more information on this classification scheme). The ICCC was developed in order to provide a standard classification of childhood tumors for comparing incidence and survival across regions and time periods. As shown, the Supplementary Table 10 age-group category total, age 0–19 year age-group count, and age-specific and age-adjusted rates are equivalent to those presented throughout this report, even though the histology grouping scheme differs from that used by CBTRUS.

Unlike other types of cancer, primary brain and other CNS tumors are not staged. They are classified according to the *WHO 2000 Classification of Tumours of the Central Nervous System*[17] which assigns a grade (grade I through grade IV) based on predicted clinical behavior. Though the WHO classification scheme was also updated in 2007[2] and 2016[18] these updated schema will not be fully implemented by US CCR until collection year 2018 or reporting year 2021. Updates made in 2007 may affect diagnostic practices used in characterization of individual tumors included in this report, though the newest revision would not affect any cases included in this report. With the increased recognition of the value of biomarkers for specific brain tumor histologies in classification, the *WHO Classification of Tumours of the Central Nervous System* has included biomarkers in its 2016 revision. However, implementing the collection of these markers in cancer registration is multi-faceted and includes an ongoing educational and training component. Collection of these markers began in the US on January 1, 2018.

WHO grading assignments are recorded by cancer registrars as Collaborative Stage Site-Specific Factor 1 - WHO Grade Classification according to the American Joint Commission on Cancer's (AJCC) Collaborative Staging (CS) schema.[19] This variable has been a required component of cancer registry data collection for brain and other CNS tumors since 2004 for SEER registries, and since 2011 for NPCR registries, and completeness of this variable has improved significantly over time.[20] Completeness of this variable is defined as having a value equal to WHO grade I, II, III, or IV. Cases where WHO grade is marked as not applicable or not documented are considered incomplete. It is not possible to conclusively determine WHO grade, which is based on the appearance of tumor cells, when a tumor is radiographically confirmed only. Some tumor types (including tumors of the pituitary and lymphomas) are often not assigned a WHO grade. This information may also be assigned but not included in the pathology report.

Anatomic location of tumor sites

Various terms are used to describe the regions of the brain and other CNS. The specific sites used in this report are broadly based on the categories and site codes defined in the SEER Site/Histology Validation List.[21] See Table 1 for an overview of CBTRUS primary site groupings. The CBTRUS Site/Validation List can be found on the CBTRUS website (http://www.cbtrus.org).

Measurement and statistical methods

Counts, means, rates, ratios, proportions, and other relevant statistics were calculated using R 3.5 statistical software[22] and/or SEER*Stat 8.3.5.[23] Figures were created in R 3.5 using the following packages: rgeos, rgdal, maptools, ggplot2, and SEER2R.[24–28] Tables were created in R 3.5 using the following packages: officer, flextable, magritter, and SEER2R.[27,29–31] As per the NPCR and CBTRUS agreement, rates are suppressed when counts are fewer than 16 within a cell but included in totals, except when data are suppressed from only one cell to prevent identification of the number in the suppressed cell. **NOTE: reported percentages may not add up to 100% due to rounding.**

Population data for each geographic region were obtained from the SEER program website[32] for the purpose of rate calculation. All rates presented in this statistical report are **age-adjusted**. Crude incidence rates are calculated by dividing the total number of cases by the total population, and cannot be compared to crude rates from other populations where the age distribution is different. Age-adjustment is a technique that is used to enable comparison between groups with different age distributions, such as rates between different states. Rates that have been age-adjusted are estimates of what the crude rate would be if the age distribution was equivalent to a standard population. Average annual age-adjusted incidence rates (AAAIR) and 95% confidence intervals (95% CI) were estimated per 100,000 population, based on one-year age groupings and standardized to the 2000 US standard population.[33] The age distribution of the 2000 US standard population is shown in Supplementary Table 2. Combined populations for the regions included in this report are also shown in Supplementary Table 3, Supplementary Table 4, 5.

CBTRUS presents statistics on the pediatric and adolescent age- group 0–19 years as suggested by clinicians, for clinical relevance. However, the 0–14 year age- group is a standard age category for childhood cancer used by other cancer surveillance organizations and has been included in this report for consistency and comparison purposes. Race categories in this report are all races, White, Black, American Indian/Alaskan Native (AIAN), and Asian/Pacific Islander (API). Other race, unspecified, and unknown race are included in statistics that are not race-specific. Hispanic ethnicity was defined using the NAACCR Hispanic Identification Algorithm, version 2, data element, which utilizes a combination of cancer registry data fields (Spanish/Hispanic Origin data element, birthplace, race, and surnames) to directly and indirectly classify cases as Hispanic or non-Hispanic.[34] The United States Department of Agriculture's 2013 Rural Urban Continuum Codes (RUCCs), which classify counties by population size and proximity to a metropolitan area, were used to classify counties either as rural or urban (rural RUCC = 4–9; urban RUCC = 1–3).[35]

When comparing two rates to one another, it is important to consider whether they are truly different or whether the difference in the estimates may be due to random error. Two methods are used in this report for determining whether two values are 'significantly different,' meaning whether the evidence meets a level of strength (usually a 5% chance of error) where the difference can be assumed to not be due to random error. The first is through the use of 95% confidence interval (CI), which were calculated for all presented rates. A 95% CI is a range around an estimate, which, if sampling of the population were to be repeated, should contain the 'true' value for the population 95% of the time. If the CI of two estimates do not overlap, these values are considered significantly different with a less than 5% probability of happening by chance. The second method used is the calculation of p-values. A p-value is the probability of finding the observed or more extreme results by chance alone, and a *P*-value of <0.05 (or <5% chance of results being due to chance) is conventionally used as a cut-off for considering a value statistically significant. Therefore, a *P*-value <0.0001 could be interpreted as meaning the observed value (or a more extreme value) had a <0.01% chance of occurring by chance alone and the difference can be considered statistically significant at the 0.01% level.

Brain tumor definition differences

NPCR, SEER, and NAACCR report brain and other CNS tumors differently from CBTRUS. The definition of primary brain and other CNS tumors used by these organizations in their published incidence and mortality statistics includes tumors located in the following sites with their ICD-O-3 site codes in parentheses: brain, meninges, and other central nervous system tumors (C70.0–9, C71.0–9, and C72.0–9), but *excludes* lymphoma and leukemia histologies (9590–9989) from all brain and other CNS sites.[3] In contrast, CBTRUS reports data on all tumor morphologies located within the Consensus Conference site definition including lymphoma and other hematopoietic histologies, as well as olfactory tumors of the nasal cavity [C30.0 (9522–9523)].[13] Additionally, CBTRUS reports data on all primary brain and other CNS tumors irrespective of behavior, whereas many reporting organizations may only publish rates for primary malignant brain and other CNS tumors due to the original mandate that focused only on malignant tumors, sometimes using the term cancer to broadly identify these tumors in their reports. **These differences in definition therefore influence the direct comparison of published rates.**

In the US, cancer registries and surveillance groups only collect data on primary CNS tumors (meaning tumors that originate within the brain and spinal cord) and do not collect data on tumors that metastasize to the brain or spinal cord from other primary sites. As a result, **only primary brain and other CNS tumors are included in this report.**

Estimation of expected numbers of brain and other CNS tumors in 2019 and 2020

Estimated numbers of expected malignant and non-malignant primary brain and other CNS tumors were calculated for 2019 and 2020. To project estimates of newly diagnosed brain and other CNS tumors in 2019 and 2020, age-adjusted annual brain tumor incidence rates were generated for 2000–2016 for malignant tumors, and 2006–2016 for non-malignant tumors. These were generated by state, age, and histologic type. Joinpoint 4.7.0.0[36] was used to fit regression models to these incidence rates,[37] which were used to predict numbers of cases in future years using the parameter from the selected models. Joinpoint regression allows for multiple lines to be fitted to incidence data across time, rather than assuming a consistent trend across the whole period. The points where these lines intersect are called 'joinpoints'. The models allowed for a maximum of two joinpoints (one for non-malignant tumors), a minimum of three observations from a joinpoint to either end of the data, and a minimum of three observations between joinpoints.[38] Modified Bayesian Information Criterion procedures included in Joinpoint were used to select the best fitting model. The overall totals presented are based on total malignant and non-malignant incidence, and the presented stratified rates may not add up to these totals. Estimated numbers of cases are highly dependent on input data. Different patterns of incidence within strata

can significantly affect the projected estimates, especially when the number of cases within a stratum is low. For state-specific projections, a model with no joinpoints was used to generate predictions as annual variability within some states was extremely high. As a result, strata-specific estimates may not equal the total estimate presented. **Caution should be used when utilizing these estimates.**

Estimation of mortality rates for brain and other CNS tumors

Age-adjusted mortality rates for deaths resulting from all primary malignant brain and other CNS tumors were calculated using the mortality data available in SEER*Stat Online Database provided by NCHS from death certificates per 100,000 population.[12] In addition to the total age-adjusted rate for the US, age-adjusted rates are presented by sex and state.

Estimation of survival rates

SEER*Stat 8.3.5 statistical software was used to estimate one-, two-, three-, four-, five-, and ten-year relative survival rates for primary malignant CNS tumor cases diagnosed between 2001–2015 in 43 NPCR CCRs and for primary non-malignant CNS tumor cases diagnosed between 2004–2015. This software utilizes life-table (actuarial) methods to compute survival estimates and accounts for current follow-up. Second or later primary tumors, cases diagnosed at autopsy, cases in which race or sex is coded as other or unknown, and cases known to be alive but for whom follow-up time could not be calculated, were excluded from survival data analyses.

Estimation of time trends

Joinpoint 4.7.0.0[36] was used to estimate incidence time trends, and generate annual percentage changes (APC) and 95% CI. The models allowed for a maximum of two joinpoints (two for non-malignant tumors), a minimum of three observations from a joinpoint to either end of the data, and a minimum of three observations between joinpoints.[38] APC is the average percent change in incidence per year over the period included in the trend segment. Time trends analysis methods were used to estimate if the APC was significantly different from 0% (meaning no change in incidence from year to year). The 95% CI is a range around an estimate that, if sampling of the population were to be repeated, should contain the 'true' value for the population 95% of the time. If the 95% CI contains zero, one cannot be confident that the 'true' population APC value is significantly different from 0%. The joinpoint regression program fits a linear regression to annual incidence rates to test significance of changes overtime, with different trends lines connected at 'joinpoints' where there are changes in the direction of incidence trends. The best fitting model was determined through permutation tests, with a minimum of three observations required between two joinpoints, as well as a minimum of three observations required between a joinpoint and either end of the data.

Data interpretation

CBTRUS works diligently to support the broader surveillance efforts aimed at improving the collection and reporting of primary brain and other CNS tumors. CCR data provided to NPCR and SEER and, subsequently, to CBTRUS vary from year-to-year due to ongoing updates in collection and data refinement aimed to improve completeness and accuracy. **Therefore, it is important to note that data from previous CBTRUS Reports cannot be compared to data in this current report, *CBTRUS Statistical Report: Primary Brain and Other Central Nervous System Tumors Diagnosed in the United States in 2012–2016. This current report supersedes all previous reports in terms of coverage of the US population with the most up-to-date population-based information available, making these data the most accurate and timely to reference.***

Several factors should be considered when interpreting the data presented in this report:

- Incident counts of cases represent individual tumors and not persons. A single person could contribute multiple counted primary tumor cases to the data included in this report. The 405,740 tumors cases, from 50 state CCR and the District of Columbia, included in this report came from 400,337 individuals. Of these 400,337 individuals, there were 5,153 individuals (1.3%) that contributed information on multiple tumors (two or more) to this report.
- Random fluctuations in average annual rates are common, especially for rates based on small case counts. The CBTRUS policy to suppress data presentation for cells with counts of fewer than 16 cases is consistent with the NPCR policy.
- A 2007 policy change guiding the Veterans Health Administration (VHA) resulted in underreporting of cancer data—especially for men—to CCR. Recent investigations suggest that underreporting for VHA facilities has diminished over time, and that the Veterans Affairs Central Cancer Registry (VACCR) now captures approximately 87–90% of cases.[40,41] It is important to note that improved reporting to VACCR does not necessarily mean that reporting to the state CCR has improved. The VACCR does not submit data to NPCR or SEER.
- Delays in reporting and late ascertainment are a reality and a known issue influencing registry completeness and, consequently, rate underestimations occur, especially for the most recent years.[42,43] The SEER and NPCR programs allow for reporting delay of up to 22–23 months prior to public data release, but additional cases may still be discovered after that point.[44] On average across all cancer sites, the submissions for the most recent diagnosis year are approximately 4% lower than the total number of cases that will eventually be submitted. This problem may be even more likely to occur in the reporting of non-malignant brain and other CNS tumors, where reporting often comes from non-hospital-based sources, such as free standing clinics or outpatient facilities.
- Type of diagnostic confirmation may also lead to increased reporting delay, with histologically confirmed tumors being subject to less reporting delay than radiographically confirmed tumors. In 2016, a study

assessing the incidence of non-malignant brain and other CNS tumors corroborated the large variation in incidence between CCR reported in this statistical report.[45] The reasons for this variation remain inconclusive but what is consistently noted is the correlation between high incidence and high proportion of non-malignant cases collected without microscopic confirmation or surgery, in other words, clinically diagnosed cases of non-malignant brain tumors. At this current time, given the variation across CCR, there is potential evidence of underreporting of non-malignant brain and other CNS tumors, the extent to which cannot be quantified.[45]

- Population estimates used for denominators affect incidence rates. CBTRUS has utilized population estimates based on the 2000 US Census for calculation of incidence and mortality rates in this report, as is standard practice in US cancer registry reporting.[46,47]

CBTRUS editing practices are reviewed, revised, and conducted yearly. These practices are aimed at refining the data for accuracy and clinical relevance and play a role in interpreting these report data. Exclusion of site and histology combinations considered invalid by the consulting neuropathologists who revised the CBTRUS site/histology validation list in 2012 may have the impact of underestimating the incidence of primary brain and other CNS tumors. Editing changes, such as the Multiple Primary and Histology Rules issued in 2007 and revised in 2018,[48,49] also incorporate updates to the cancer registration coding rules that influence case ascertainment and data collection.[3]

Supplemental Data

CBTRUS has made supplemental additional figures and tables available. These materials are noted in the text as Supplementary Tables and Figures.

Results

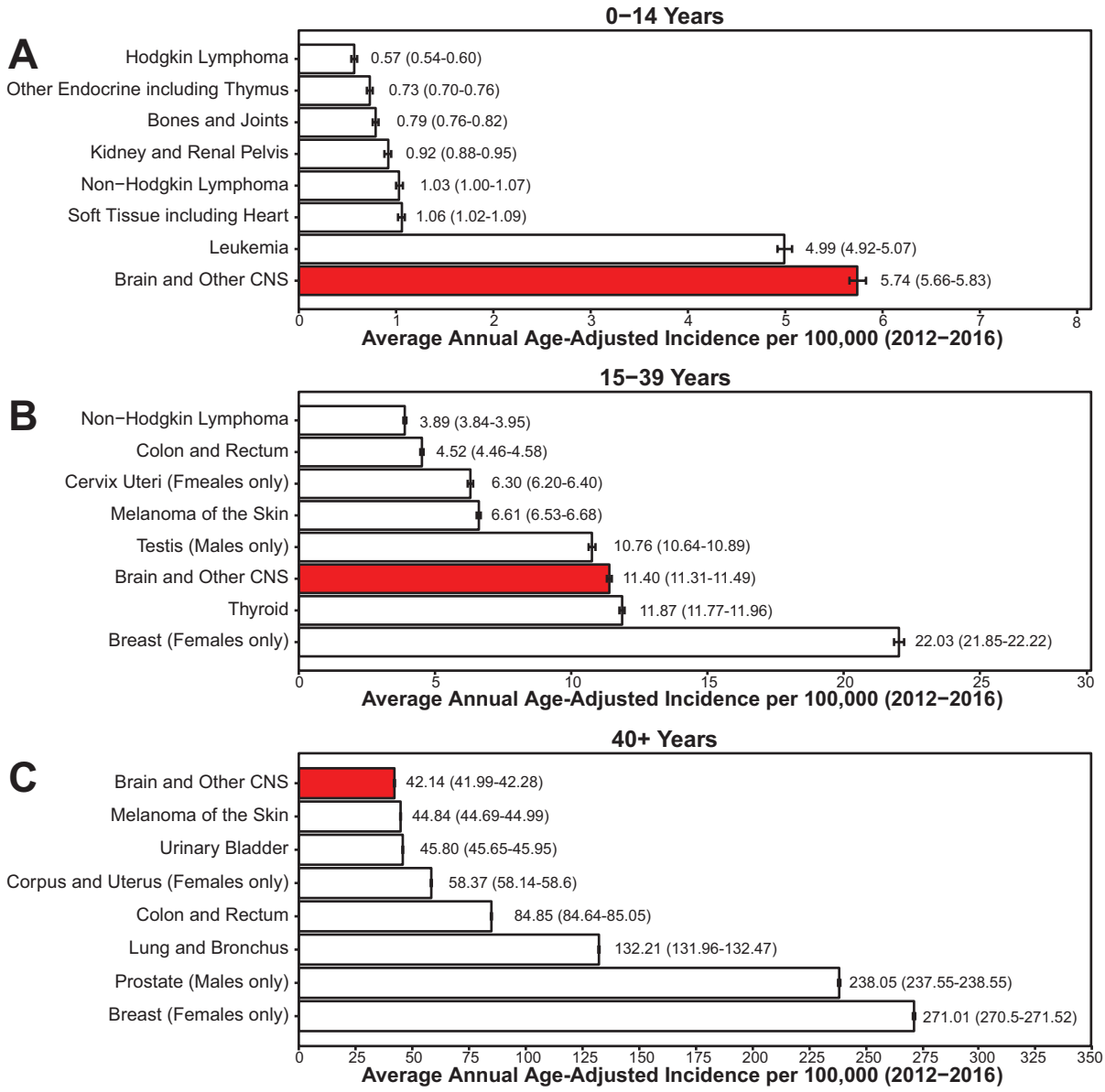
Incidence and Mortality in Comparison to Other Common Neoplasms in the US

AAAIR for **all** primary brain and other CNS tumors (2012–2016) and a selection of common cancers (USCS, 2012–2016) in the US are presented by age in Figure 3A: Children (Age 0–14 Years), Figure 3B: Adolescents and Young Adults (Age 15–39 Years), and Figure 3C: Older Adults (Age 40+ Years). Incidence rates stratified by sex are presented by age in Supplementary Figure 1 and Supplementary Figure 2, respectively. Please see Supplementary Table 6 for incidence rates of comparison cancers.

- **Brain and other CNS tumors (both malignant and non-malignant) were the most common cancer site in persons age 0–14 years, with AAAIR of 5.74 per 100,000 population. Brain and other CNS tumors were the most common cancer in both males and females in this age group.**
- Leukemia was the second most common neoplasm in persons age 0–14 years, with an AAAIR of 4.99 per 100,000 population. Leukemia was the second most common cancer in both males and females in this age group.
- **Brain and other CNS tumors (both malignant and non-malignant) among those age 15–39 years had an AAAIR of 11.40 per 100,000 population. These tumors were the third most common cancer overall, the second most common cancer in males in this age group, and the third most common cancer in females in this age group.**
- Testicular cancer was the most common cancer in males age 15–39 years, with an AAAIR of 10.76 per 100,000.
- Breast cancer was the most common cancer among females age 15–39 years, with an AAAIR of 22.03 per 100,000.
- **Brain and other CNS tumors (both malignant and non-malignant) were the eighth most common cancer among persons age 40+ years with an AAAIR of 42.14 per 100,000 population. These tumors were the eighth most common cancer among males and the fifth most common cancer among females in this age group.**
- Prostate and breast cancer were the most common cancers among those age 40+ years in the US, with an AAAIR of 238.05 per 100,000 population (males only) and 271.01 per 100,000 (females only) population, respectively.[10]

Average annual age-adjusted mortality rates (AAAMR) for primary malignant brain and other CNS tumors (NVSS 2012–2016), a selection of common cancers, and the top three non-cancer causes of death in the US are presented by age in Figure 4A: (Age 0–14 Years), Figure 4B: (Age 15–39 Years), and Figure 4C: (Age 40+ Years). Mortality rates for males only and females only are presented by age in Supplementary Figure 3 and Supplementary Figure 4, respectively. Please see Supplementary Table 7 for mortality rates in relation to comparison cancers and other non-cancer conditions.

- **Malignant** brain and other CNS tumors among persons age 0–14 years had an AAAMR of 0.72 per 100,000 and were the seventh most common cause of death in this age-group, and the most common cause of cancer death.
- **Childhood brain and CNS cancer, while rare, contributes substantially to cancer-related mortality in this population, surpassing other cancers as the top reason for cancer mortality in those age 0–14 years at death.**[50]
- The most common causes of death in persons age 0–14 years were conditions originating in the perinatal period (19.20 per 100,000).
- **Malignant** brain and other CNS tumors among persons age 15–39 years had an AAAMR of 0.97 per 100,000 and were the twelfth most common cause of death in this age group and the second most common cause of cancer death, where their AAAMR was equal to that of leukemia. The most common cause of cancer death in this age-group was female breast cancer.
- Accidents and adverse effects were the leading causes of death in persons age 15–39 years (36.75 per 100,000).
- **Malignant** brain and other CNS tumors among persons age 40+ years had an AAAMR of 9.10 per 100,000, and were the twenty-seventh most common cause of death and the thirteenth most common cause of cancer death. The most common cause of cancer death in this age-group was lung and bronchus cancer.
- Heart disease was the largest contributor to mortality in persons age 40+ years in the US, with an AAAMR of 383.16 per 100,000 for major cardiovascular diseases.



a. Rates per 100,000 and age–adjusted to the 2000 United States standard population.

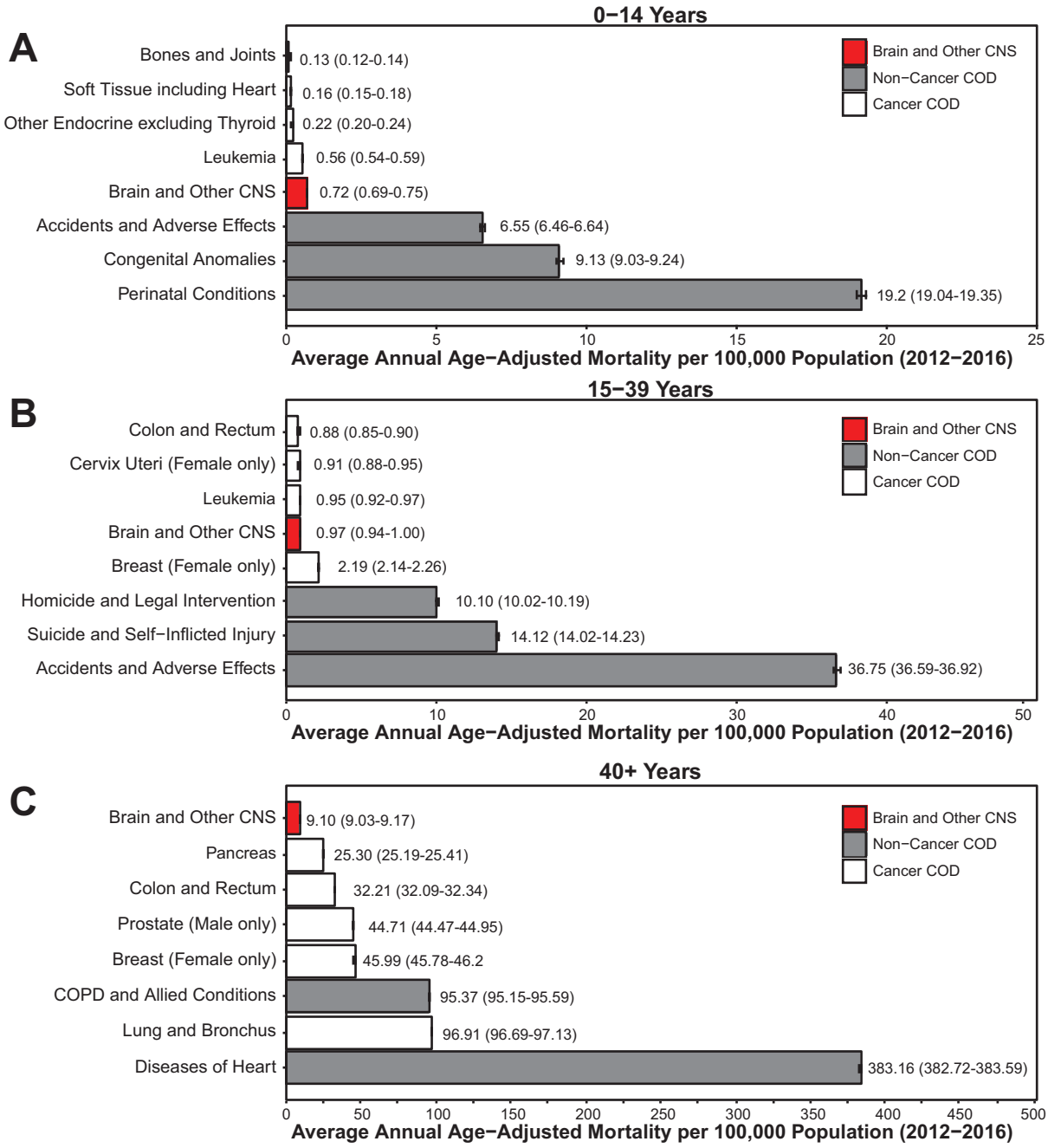
Fig. 3 Average Annual Age-Adjusted Incidence Rates[a] with 95% Confidence Intervals of All Primary Brain and Other CNS Tumors in Comparison To Top Eight Highest Incidence Cancers for A) Children Age 0–14 Years, B) Adolescents and Young Adults Age 15–39 Years, and C) Older Adults Age 40+ Years, CBTRUS Statistical Report: US Cancer Statistics - NPCR and SEER 2012–2016

Distributions and Incidence by Site, Behavior, Histology, and Year

Counts and rates from the 405,740 incident brain and other CNS tumors (122,569 malignant; 283,171 non-malignant shown in Figure 5) reported to 50 state CCR and the District of Columbia during 2012–2016 by histology, behavior, and sex for all ages are presented in Table 3. Counts and rates are shown by histology and behaviors for selected histologies where there is a sufficient number of cases to calculate rates. The predominant tumor categories by behavior are presented in Supplementary Figures 5, 6.

Incidence by year and behavior

Figure 6 presents the overall AAAIR of **all** primary brain and other CNS tumors by year, 2012–2016, and behavior. AAAIR for all primary brain and other CNS tumors, 2012–2016, did not differ substantially by year (both overall and



a. Rates per 100,000 and age–adjusted to the 2000 United States standard population.

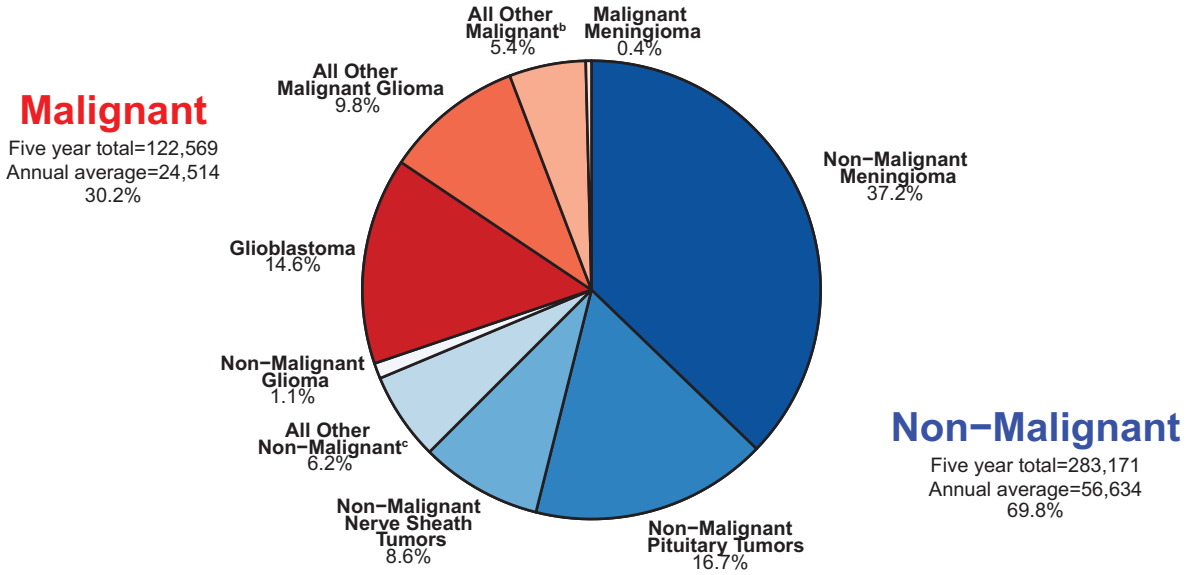
Fig. 4 Average Annual Age-Adjusted Mortality Rates[a] with 95% Confidence Intervals of All Primary Brain and Other CNS Tumors in Comparison To Top Five Causes of Cancer Death and Top Three Non-Cancer Causes of Death (COD) for A) Children Age 0–14 Years, B) Adolescents and Young Adults Age 15–39 Years, and C) Older Adults Age 40+ Years, CBTRUS Statistical Report: NVSS 2012–2016

by behavior). AAAIR stratified by sex are presented in Supplementary Figure 7.

Distribution of tumors by site and histology

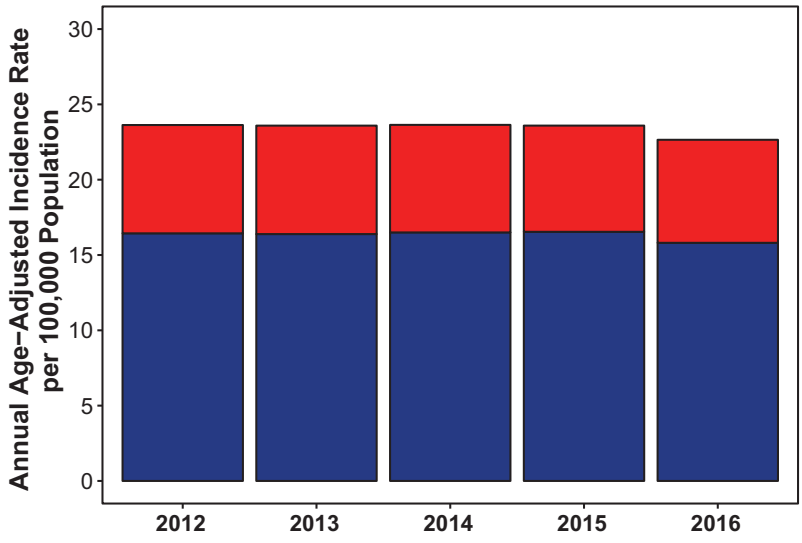
The distribution of **all** brain and other CNS tumors by site is shown in Figure 7A.

- Overall, the most common tumor site was the meninges, representing 37.7% of all tumors.
- Frontal (8.0%), temporal (5.9%), parietal (3.4%), and occipital lobes (0.9%) accounted for 18.2% of all tumors.
- The cranial nerves and the spinal cord/cauda equina accounted for 10.1% of all tumors.
- The pituitary and craniopharyngeal duct accounted for 17.8% of all tumors.



a. Percentages may not add up to 100% due to rounding. b. Includes histologies with ICD−O−3 behavior code of /3 from choroid plexus tumors, neuronal and mixed neuronal−glial tumors, tumors of the pineal region, embryonal tumors, nerve sheath tumors, mesenchymal tumors, primary melanocytic lesions, other neoplasms related to the meninges, lymphoma, other hematopoietic neoplasms, germ cell tumors, cysts and heterotopias, tumors of the pituitary, craniopharyngioma, hemangioma, neoplasm unspecified, and all other (Table 2). c. Includes histologies with ICD−O−3 behavior code of /0 or /1 from neuronal and mixed neuronal−glial tumors, tumors of the pineal region, embryonal tumors, other tumors of cranial and spinal nerves, mesenchymal tumors, primary melanocytic lesions, other neoplasms related to the meninges, other hematopoietic neoplasms, germ cell tumors, cysts and heterotopias, craniopharyngioma, hemangioma, neoplasm unspecified, and all other (Table 2).

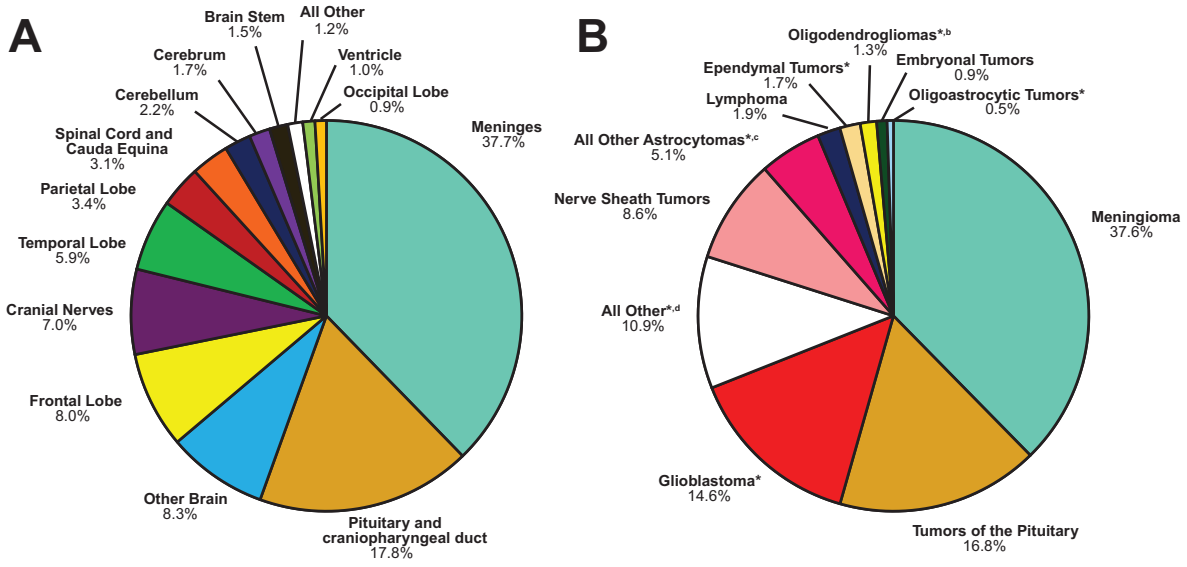
Fig. 5 Distribution[a] of Primary Brain and Other CNS Tumors by Behavior (Five-Year Total = 405,740; Annual Average Cases = 81,148), CBTRUS Statistical Report: US Cancer Statistics - NPCR and SEER, 2012–2016



	2012	2013	2014	2015	2016
Malignant	7.19	7.20	7.14	7.05	6.84
Non−Malignant	16.44	16.39	16.50	16.54	15.81

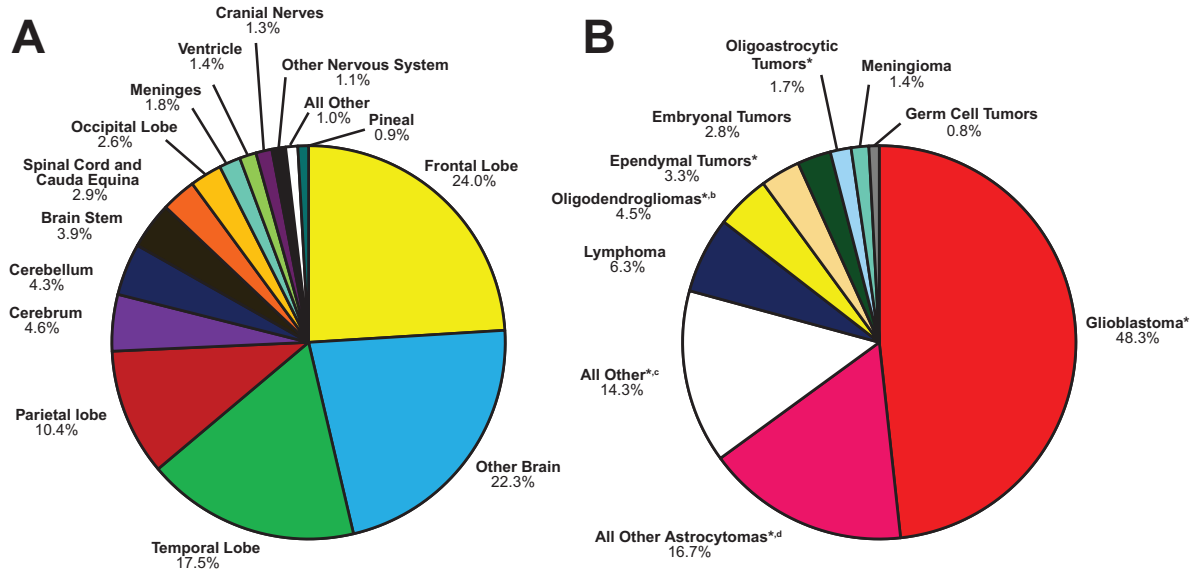
a. Rates per 100,000 and age−adjusted to the 2000 United States standard population.

Fig. 6 Annual Age-Adjusted Incidence Rates[a] of Primary Brain and Other CNS Tumors by Year and Behavior, CBTRUS Statistical Report: US Cancer Statistics - NPCR and SEER, 2012–2016



* All or some of this histology is included in the CBTRUS definition of gliomas, including ICD–O–3 histology codes 9380–9384 and, 9391–9460 (Table 2). a. Percentages may not add up to 100% due to rounding. b. Includes oligodendroglioma and anaplastic oligodendroglioma (Table 2). c. Includes pilocytic astrocytoma, diffuse astrocytoma, anaplastic astrocytoma, and unique astrocytoma variants (Table 3). d. Includes glioma malignant, NOS, choroid plexus tumors, other neuroepithelial tumors, neuronal and mixed neuronal–glial tumors, tumors of the pineal region, other tumors of cranial and spinal nerves, mesenchymal tumors, primary melanocytic lesions, other neoplasms related to the meninges, other hematopoietic neoplasms, hemangioma, neoplasm, unspecified, and all other (Table 2).

Fig. 7 Distribution[a] of All Primary Brain and Other CNS Tumors (Five-Year Total = 405,740; Annual Average Cases = 81,148), by A) Site and B) Histology, CBTRUS Statistical Report: US Cancer Statistics - NPCR and SEER, 2012–2016



* All or some of this histology is included in the CBTRUS definition of gliomas, including ICD–O–3 histology codes 9380–9384 and, 9391–9460 (Table 2). a. Percentages may not add up to 100% due to rounding. b. Includes oligodendroglioma and anaplastic oligodendroglioma (Table 2). c. Includes glioma malignant, NOS, choroid plexus tumors, other neuroepithelial tumors, neuronal and mixed neuronal–glial tumors, tumors of the pineal region, nerve sheath tumors, other tumors of cranial and spinal nerves, mesenchymal tumors, primary melanocytic lesions, other neoplasms related to the meninges, other hematopoietic neoplasms, hemangioma, neoplasm, unspecified, and all other (Table 2). d. Includes pilocytic astrocytoma, diffuse astrocytoma, anaplastic astrocytoma, and unique astrocytoma variants (Table 2).

Fig. 8 Distribution[a] of Malignant Primary Brain and Other CNS Tumors (Five-Year Total = 122,569; Annual Average Cases = 24,514), by A) Site and B) Histology, CBTRUS Statistical Report: US Cancer Statistics - NPCR and SEER, 2012–2016

- For **malignant** tumors, frontal (24.0%), temporal (17.5%), parietal (10.4%), and occipital (2.6%) accounted for 54.5% of tumors (Figure 8A).
- For **non-malignant** tumors, 53.3% of all tumors occurred in the meninges (Figure 9A).

Distribution of **all** brain and other CNS tumors by site in males only is shown in Supplementary Figure 8, and distribution of **all** brain and other CNS tumors by site in females only is shown in Supplementary Figure 9.

The distribution of all primary brain and other CNS tumors by histologies is shown in Figure 7B.

- **The most frequently reported histology overall was meningioma** (37.6%), followed by tumors of the pituitary (16.8%) and glioblastoma (14.6%).
- Tumors of the pituitary and nerve sheath tumors combined accounted for slightly more than one-fourth of all tumors (25.4%), the vast majority of which were non-malignant.

The distribution of malignant and non-malignant brain and other CNS tumors by histology are shown in Figure 8B and Figure 9B, respectively, as well as in Table 3.

- The most common of all **malignant** CNS tumors was glioblastoma (48.3%).
- The most common of all **non-malignant** tumors was meningioma (53.3%).
- The most common **non-malignant** nerve sheath tumor (based on multiple sites in the brain and CNS) was vestibular schwannoma (defined by histology code 9560, also formerly called acoustic neuromas) (95.7%).

Distribution of **all** brain and other CNS tumors by histology in males only is shown in Supplementary Figure 10, and distribution of **all** brain and other CNS tumors by histology in females only is shown in Supplementary Figure 11.

Distribution of Gliomas by site and histology

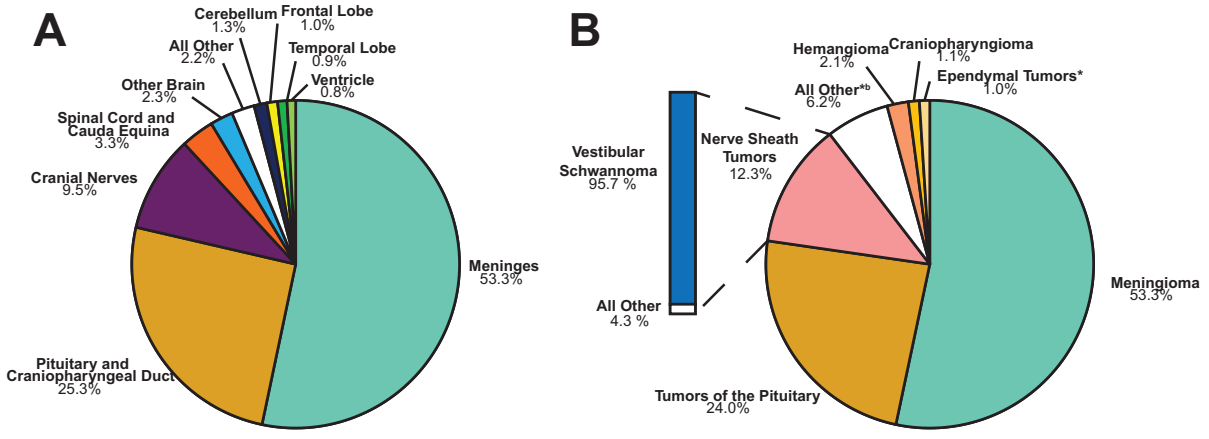
The broad category glioma (ICD-O-3 histology codes 9380–9384, 9391–9460, see Table 2 and footnotes for more information) represented approximately 25.5% of all primary brain and other CNS tumors and 80.8% of **malignant** tumors. The distribution of gliomas by site and histology are shown in Figure 10A and Figure 10B, respectively.

- The majority of gliomas occurred in the supra-tentorium (frontal, temporal, parietal, and occipital lobes combined) (61.3%). Only a very small proportion of gliomas occurred in areas of the CNS other than the brain.
- Glioblastoma accounted for the majority of **gliomas** (57.3%).
- Astrocytic tumors (pilocytic astrocytoma, anaplastic astrocytoma, diffuse astrocytoma, glioblastoma, all other gliomas) accounted for 76.4% of all **gliomas**.

Incidence rates by major histology grouping, specific histologies, and behavior

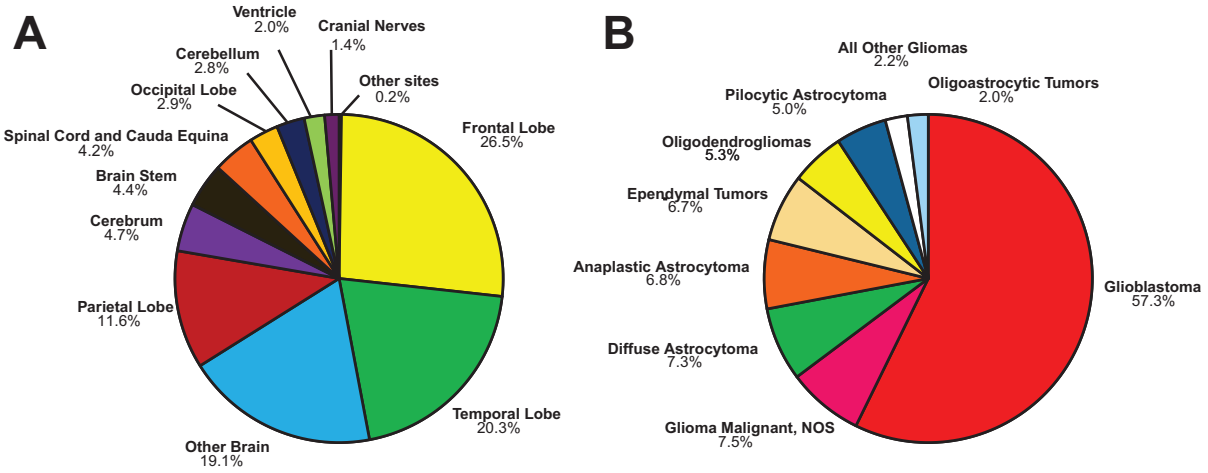
Incidence rates overall by major histology grouping, specific histology, and behavior are provided in Table 3.

- Among CBTRUS major histology groupings, AAAIR were highest for tumors of the meninges (8.83 per 100,000 population), followed by tumors of the neuroepithelial tissue (6.56 per 100,000 population), tumors of the sellar region (4.27 per 100,000 population), and tumors of the cranial and spinal nerves (2.01 per 100,000 population).
- Among CBTRUS specific histologies, AAAIR were highest for meningiomas (8.58 per 100,000 population), tumors of the pituitary (4.08 per 100,000 population), glioblastomas (3.22 per 100,000 population), and nerve sheath tumors (2.01 per 100,000 population).
- The majority of nerve sheath tumors are vestibular schwannoma (1.90 per 100,000, Table 4)



* All or some of this histology is included in the CBTRUS definition of gliomas, including ICD–O–3 histology codes 9380–9384 and, 9391–9460 (Table 2). a. Percentages may not add up to 100% due to rounding. b. Includes unique astrocytoma variants, choroid plexus tumors, other neuroepithelial tumors, neuronal and mixed neuronal–glial tumors, tumors of the pineal region, embryonal tumors, other tumors of cranial and spinal nerves, mesenchymal tumors, primary melanocytic lesions, other neoplasms related to the meninges, other hematopoietic neoplasms, germ cell tumors, neoplasm, unspecified, and all other (Table 2).

Fig. 9 Distribution[a] of Non-Malignant Primary Brain and Other CNS Tumors (Five-Year Total = 283,171; Annual Average Cases = 56,634), by A) Site and B) Histology, CBTRUS Statistical Report: US Cancer Statistics - NPCR and SEER, 2012–2016



a. Percentages may not add up to 100% due to rounding. b. ICD–O–3 histology codes 9380–9384 and 9391–9460 (Table 2).

Fig. 10 Distribution[a] of Primary Brain and Other CNS Gliomas[b] (Five-Year Total = 39,917; Annual Average Cases = 7,983) by A) Site and B) Histology Subtypes, CBTRUS Statistical Report: US Cancer Statistics - NPCR and SEER, 2012–2016

- For **malignant** tumors, AAAIR was highest for glioblastoma (3.22 per 100,000 population), followed by glioma malignant, NOS (0.49 per 100,000), diffuse astrocytoma (0.46 per 100,000 population), and lymphoma (0.43 per 100,000 population).
- For **non-malignant** tumors, AAAIR was highest for meningioma (8.6 per 100,000 population), followed by tumors of the pituitary (4.07 per 100,000 population).

Distributions and Incidence by Age

Incidence rates by age

The overall AAAIR for 2012–2016 for **all** primary brain and other CNS tumors was 23.41 per 100,000 population (Table 3). The AAAIR was 5.74 per 100,000 population for children age 0–14 years, 11.40 per 100,000 population for adolescents and young adults age 15–39 years, and 42.14 per 100,000 population for adults age 40+ years (Table 5). AAAIR of tumors by behavior and age group (age 0–19 years and 20+ years) are shown in Figure 11. AAAIR stratified by sex are presented in Supplementary Figure 12.

Incidence rates by age and histology

AAAIR by age and histology at diagnosis are presented in Tables 5–7, as well as in Figure 12A (Age 20+ Years), and Figure 12B (Age 0–19 Years).

- The incidence rate for **all** brain and other CNS tumors was highest among age 85+ years (84.48 per 100,000 population) and
- The incidence rate for **all** brain and other CNS tumors was lowest among children and adolescents age 0–19 years (6.06 per 100,000 population), while incidence among those 20+ was 30.40 per 100,000 population.
- Incidence rates of pilocytic astrocytoma, germ cell tumors, and embryonal tumors were higher in the younger age groups and decreased with advancing age.
- Incidence rates of meningioma increased with age.
- Incidence rates declined with increasing age for those ages 0–19 years, particularly for the gliomas and embryonal tumors (primitive neuroectodermal tumor (PNET), Atypical teratoid/rhabdoid tumor (ATRT), and medulloblastoma).
- Incidence rates increased with age for tumors of the pituitary.

Median age at diagnosis

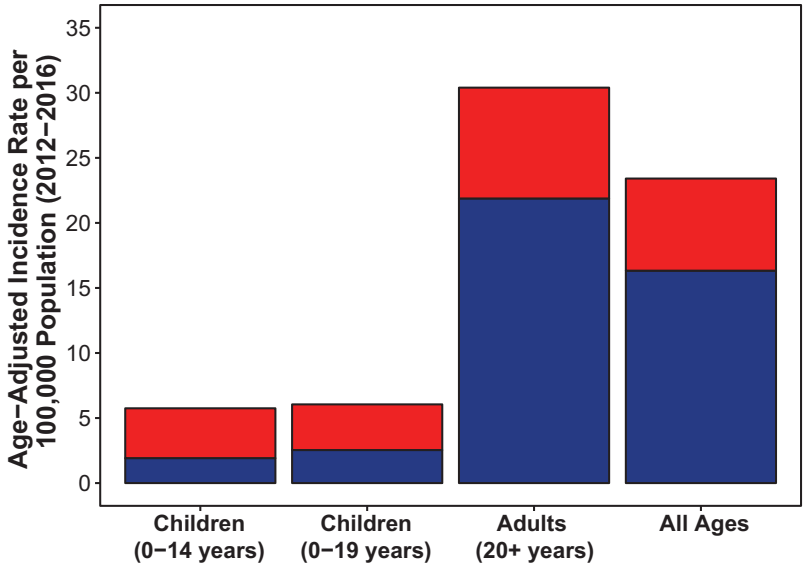
The median age at diagnosis for **all** primary brain and other CNS tumors was 60 years (Table 3), and was 60 years for both males and females (data not shown).

- The histology-specific median ages ranged from 8 years for embryonal tumors to 69 years for neoplasm, unspecified.
- Pilocytic astrocytoma, choroid plexus tumors, neuronal and mixed neuronal-glial tumors, tumors of the pineal region, embryonal tumors, and germ cell tumors and cysts were histologies with younger median ages at diagnosis compared to other histologies.
- Meningioma and glioblastoma were primarily diagnosed at older ages (median age of 66 and 65 years, respectively).

Distributions and Incidence by Sex

Distribution by sex and behavior

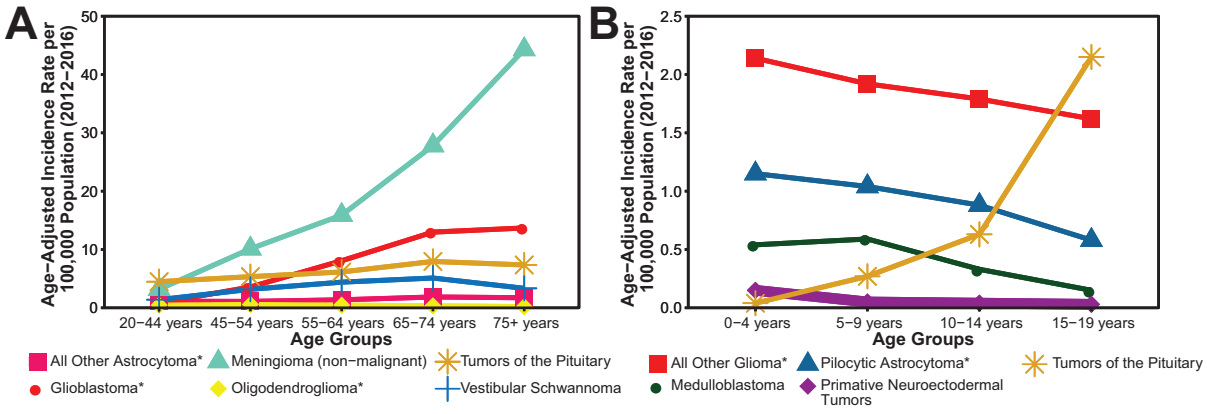
- Overall, 41.9% of **all** tumors diagnosed between 2012 and 2016 occurred in males (169,868 tumors) and 58.1% in females (235,872 tumors) (Table 3).



	Children (0−14 years)	Children (0−19 years)	Adults (20+ years)	All Ages
Malignant	3.83	3.51	8.52	7.08
Non−Malignant	1.92	2.54	21.88	16.33

a. Rates per 100,000 and age−adjusted to the 2000 United States standard population.

Fig. 11 Average Annual Age-Adjusted Incidence Rates[a] of All Primary Brain and Other CNS Tumors by Age and Behavior, CBTRUS Statistical Report: US Cancer Statistics - NPCR and SEER, 2012–2016



* All or some of this histology are included in the CBTRUS definition of gliomas, including ICD−O−3 histology codes 9380−9384, 9391−9460 (Table 2). a. Rates per 100,000 and age−adjusted to the 2000 United States standard population. b. Scales of plot vary by age group. c. ICD−O−3 Histology Codes: 9381, 9384, 9424, 9400, 9401, 9410, 9411, and 9420, all ICD−O−3 behavior codes. d. ICD−O−3 Histology and Behavior Codes: 9530/0, 9530/1, 9531/0, 9532/0, 9533/0, 9534/0, 9537/0, 9538/1, and 9539/1. e. ICD−O−3 Histology Codes: 9450, 9451, and 9460, with ICD−O−3 behavior code of 3. f. ICD−O−3 Histology Code: 9560, with ICD−O−3 behavior code of 3. g. ICD−O−3 Histology Codes: 9380−9384, 9391−9420, 9422−9460, and 9480, all ICD−O−3 behavior codes. h. ICD−O−3 Histology Codes: 9470, 9471, 9472, and 9474, with ICD−O−3 behavior code of 3. i. ICD−O−3 Histology Code: 9473, with ICD−O−3 behavior code of 3.

Fig. 12 Age-Adjusted Incidence Rates[a] of Brain and Other CNS Tumors by Selected Histologies and Age Group A) Age 20+ Years[b] and B) Age 0–19 Years[b], CBTRUS Statistical Report: US Cancer Statistics - NPCR and SEER, 2012–2016

- Approximately 55.4% of the **malignant** tumors occurred in males (67,930 tumors between 2011 and 2016) and 44.6% in females (54,639 tumors between 2012 and 2016).
- Approximately 36.0% of the **non-malignant** tumors occurred in males (101,938 tumors between 2012 and 2016) and 64.0% in females (181,233 tumors between 2012 and 2016).

Incidence rates by site and sex

Incidence counts and AAAIR for **all** brain and other CNS tumors by site and sex are provided in Table 8.

- AAAIR were highest for tumors located in the meninges (8.58 per 100,000 population) and lowest for olfactory tumors of the nasal cavity (0.04 per 100,000 population).
- AAAIR were higher in females than in males for tumors located in the meninges (11.64 per 100,000 in females vs 5.11 per 100,000 in males), pituitary and craniopharyngeal duct (4.77 per 100,000 in females vs 3.99 per 100,000 in males), and cranial nerves (1.68 per 100,000 in females vs 1.60 per 100,000 in males) while males had higher AAAIR for tumors located in most other locations.

Incidence rates by sex and histology

AAAIR by sex and histology are presented in Table 3. AAAIR for **all** primary brain and other CNS tumors combined were higher among females (25.84 per 100,000 population) than males (20.82 per 100,000 population).

- The AAAIR of tumors of neuroepithelial tissue was higher in males (7.69 per 100,000 population) than in females 5.56 per 100,000 population).
- The AAAIR of tumors of meninges was higher in females (11.89 per 100,000 population) than in males (5.37 per 100,000 population).

Incidence rate ratios (male:female) for selected histologies and histology groupings are shown in Figure 13.

- Incidence was higher in males for many histologies, such as germ cell tumors ($P < 0.001$), most glial tumors, lymphomas ($P < 0.001$), and embryonal tumors ($P < 0.001$).
- Incidence was higher in females for non-malignant ($P < 0.001$) and malignant ($P = 0.0153$) meningiomas and tumors of the pituitary ($P < 0.001$).

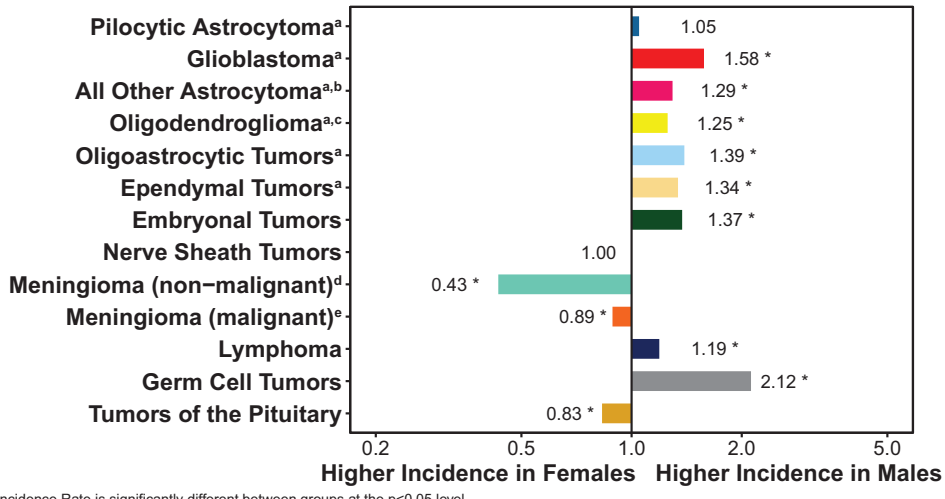
Distribution and Incidence Rates by CCR, Age, Diagnostic Confirmation, and Behavior

The overall number of reported tumors is listed by CCR in Table 9. While most malignant tumors are diagnosed by histologic confirmation (where the patient receives surgery and diagnosis is confirmed by a pathologist), brain and other CNS tumors may also be diagnosed by radiographic confirmation only (where the tumor was visualized on MRI, CT, X-ray, or other imaging technology but surgery, including biopsy, was not performed and tissue therefore could not be collected).

- Approximately 69.8% of tumors were **non-malignant**, but there was variation by cancer registry (range: 57.2%-79.1%).
- Overall, 56.3% of tumors were histologically confirmed. A larger proportion of **malignant** tumors were histologically confirmed (84.4%) compared to **non-malignant** tumors (44.1%).
- A slight majority of **non-malignant** brain and other CNS tumors were radiographically confirmed (52.6%).

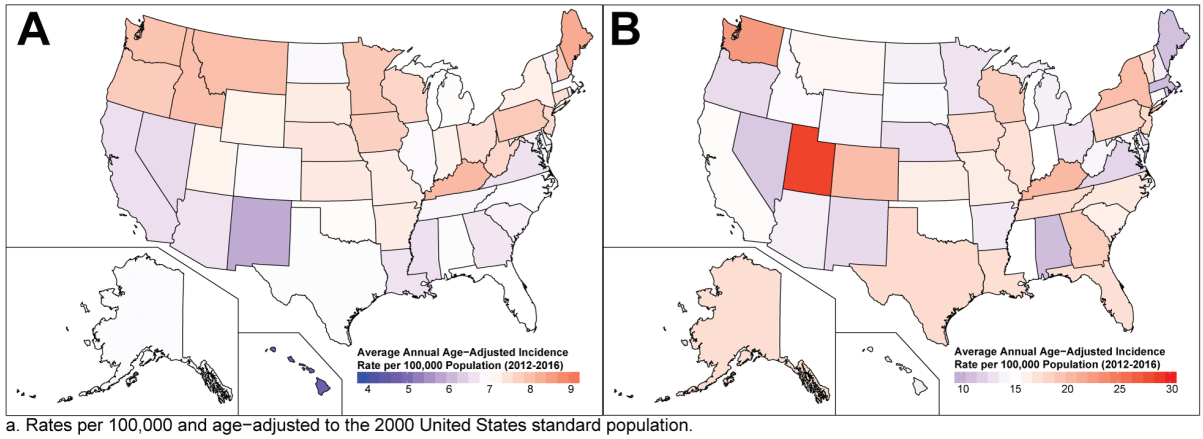
The overall AAAIR by age, behavior, and CCR are presented in Table 10 and Figure 14.

- The overall AAAIR of all tumors (**malignant and non-malignant**) for each individual CCR ranged from 17.72 to 35.71 per 100,000 population. Please see Supplementary Figure 13 for combined incidence of **malignant** and **non-malignant** tumors by CCR.



* Incidence Rate is significantly different between groups at the p<0.05 level.
a. All or some of this histology are included in the CBTRUS definition of gliomas, including ICD−O−3 histology codes 9380−9384 and 9391−9460 (Table 4). b. ICD−O−3 Histology Codes: 9381, 9384, 9424, 9400, 9401, 9410, 9411, and 9420, all ICD−O−3 behavior codes. c. ICD−O−3 Histology and Behavior Codes: 9450/3, 9451/3, and 9460/3. d. ICD−O−3 Histology and Behavior Codes: 9530/0, 9530/1, 9531/0, 9532/0, 9533/0, 9534/0, 9537/0, 9538/1, and 9539/1. e. ICD−O−3 Histology and Behavior Codes: 9530/3, 9538/3, and 9539/3.

Fig. 13 Incidence Rate Ratios by Sex (Males:Females) for Selected Primary Brain and Other CNS Tumor Histologies, CBTRUS Statistical Report: US Cancer Statistics - NPCR and SEER, 2012–2016



a. Rates per 100,000 and age–adjusted to the 2000 United States standard population.

Fig. 14 Average Annual Age-Adjusted Incidence Rates[a] of A) Malignant and B) Non-Malignant Primary Brain and Other CNS Tumors by Central Cancer Registry, CBTRUS Statistical Report: US Cancer Statistics - NPCR and SEER, 2012–2016

- AAAIR of all primary **malignant** tumors ranged from 4.73 to 8.32 per 100,000 population, and AAAIR of all primary **non-malignant** tumors ranged from 10.80 to 28.49 per 100,000 population.
- There was less variation by region for **malignant** tumor incidence rates (Fig. 14A) compared to incidence rates for **non-malignant** tumors (Fig. 14B). CCR and regional variations likely reflect differences in reporting and case ascertainment practices.
- Among adults 20 years of age and older, CCR-specific AAAIR ranged from 5.94 to 10.16 per 100,000 population for **malignant** tumors and from 14.26 to 38.65 per 100,000 population for **non-malignant** tumors.
- In persons less than 20 years of age, incidence rates ranged from 1.72 to 4.63 per 100,000 population for **malignant** tumors and from 1.33 to 3.93 per 100,000 population for **non-malignant** tumors.

Distribution by histology, WHO grade, diagnostic confirmation, and treatment completeness

The distribution of reported tumors with histologically confirmed diagnosis from 2012 to 2016 is listed by histology and reported WHO grade in Table 11.

- Overall, 56.5% of tumors had histologic confirmation (85.3% of **malignant** tumors and 44.1% of **non-malignant** tumors).
- The proportion of tumors with histologic confirmation varied substantially by histology, with the highest proportion in anaplastic astrocytoma (99.2%) and oligoastrocytic tumors (99.2%). The proportion with histologic confirmation was lowest in neoplasm unspecific (12.3%), hemangioma (29.3%), glioma malignant, NOS (33.8%) and **non-malignant** meningioma (39.5%).
- Overall, 62.9% of tumors had complete WHO grade information, but there was substantial variation by histology.
- The histologic types with the highest WHO grade completeness were anaplastic oligodendroglioma (95.1%), oligoastrocytic tumors (95.0%), and anaplastic astrocytoma (94.8%).

Incidence by urban or rural residence

Incidence counts and AAAIR for brain and other CNS tumors are shown by urban/rural residence and histology in Supplementary Table 8. Incidence of selected histologies by urban/rural residence is show in Figure 15.

- The overall incidence of brain and other CNS tumors was 11% higher in urban areas as compared to rural areas (23.22 per 100,000 and 20.80 per 100,000, respectively, $P < 0.0001$).
- Incidence of malignant brain and other CNS tumors was slightly higher in urban areas (6.90 per 100,000) as compared to rural areas (6.80 per 100,000, $P = 0.0822$).
- Incidence of **non-malignant** brain and other CNS tumors was 17% higher in urban areas as compared to rural areas (16.33 per 100,000 and 14.00 per 100,000, respectively, $P < 0.0001$).
- Incidence of glioblastoma (3%, $P = 0.436$) was higher in urban as compared to rural areas.
- **Non-malignant** histologies were primarily diagnosed more frequently in urban areas, including meningioma (18% higher, $P < 0.0001$), nerve sheath tumors (20% higher, $P < 0.0001$), and tumors of the pituitary (20% higher, $P < 0.0001$).

Distribution of tumors in Puerto Rico

The distribution of **all** brain and other CNS tumors diagnosed among residents of Puerto Rico by histology is shown in Supplementary Figure 14.

- Approximately 39.4% of tumors were **malignant** and 60.6% were **non-malignant**.
- Non-malignant meningioma was the most common tumor type (26.3%), followed by glioblastoma (18.1%).

Incidence Rates by Race and Histology

AAAIR by race and histology are shown in Table 12.

- AAAIR for **all** primary brain and other CNS tumors combined were lower for race groups AIAN (14.28 per 100,000 population) compared to Whites (23.50 per 100,000 population), Blacks (23.34 per 100,000 population), and API (18.18 per 100,000 population).
- AAAIR for **non-malignant** primary brain and other CNS tumors were highest in Blacks (18.87 per 100,000) compared to Whites (15.92 per 100,000), AIAN (10.76 per 100,000), and API (13.93 per 100,000).
- AAAIR for **malignant** primary brain and other CNS tumors were highest in Whites (7.58 per 100,000) compared to Blacks (4.48 per 100,000), AIAN (3.51 per 100,000), and API (4.25 per 100,000).
- AAAIR for meningioma, tumors of the pituitary, and craniopharyngioma observed for Blacks exceeded those observed for Whites, AIAN, and API.
- The AAAIR for tumors of the cranial and spinal nerves in the API group was the highest for all racial groups.

Incidence rate ratios (White:Black) for selected histologies are shown in Figure 16.

- Incidence rates for glioblastoma ($P < 0.0001$), all other astrocytoma ($P < 0.0001$), and nerve sheath tumors ($P < 0.0001$) were approximately 2 times greater in Whites than in Blacks.
- Incidence of oligodendroglioma was approximately 2.28 times greater in Whites than in Blacks ($P < 0.0001$).
- Incidence rates for pilocytic astrocytoma ($P < 0.0001$), ependymal tumors ($P < 0.0001$), embryonal tumors ($P < 0.0001$), lymphoma ($P < 0.0001$), and germ cell tumors ($P < 0.0001$) were also higher among Whites than Blacks.
- Incidence rates for **non-malignant** ($P < 0.0001$) and **malignant** ($P < 0.0001$) meningioma and tumors of the pituitary ($P < 0.0001$) were higher among Blacks than Whites.

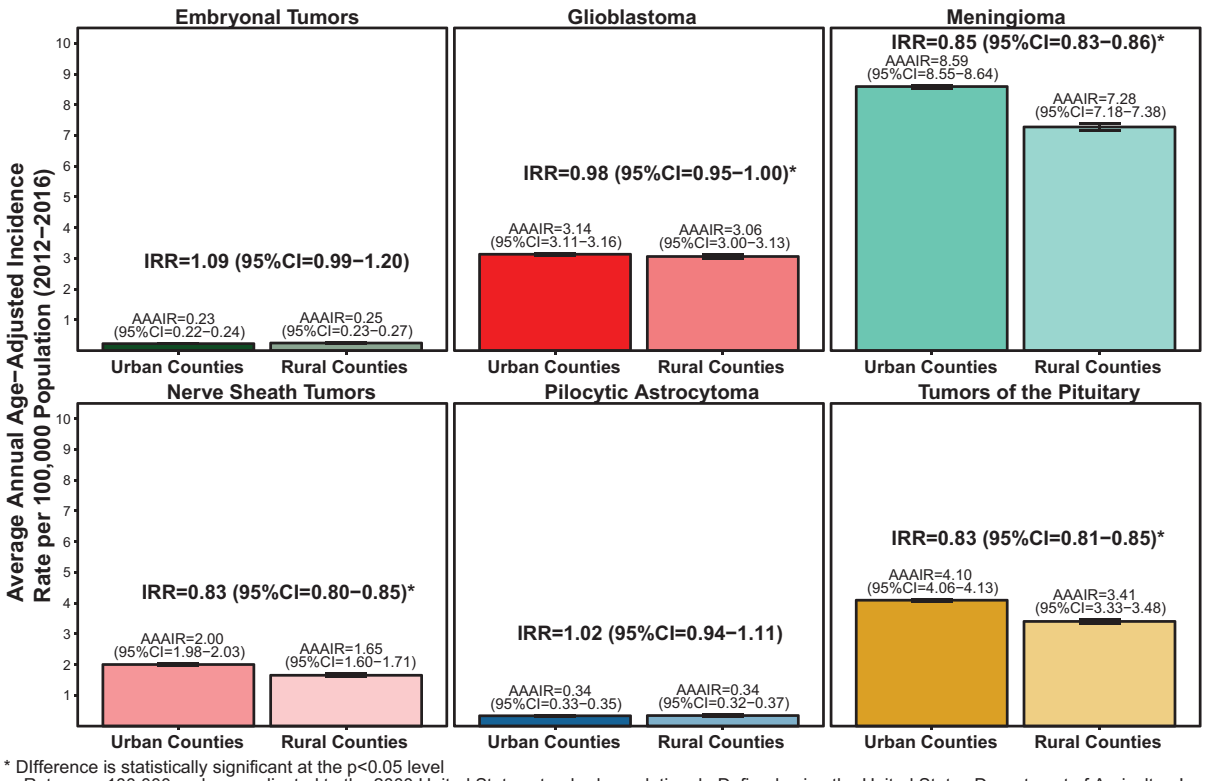
Incidence rate ratios (White:API) for selected histologies are shown in Figure 16.

- Incidence rates for glioblastoma ($P < 0.0001$) were over 2.39 times greater in Whites than in API.
- Incidence of germ cell tumors was approximately 22% higher in API compared to Whites ($P < 0.0001$).

Incidence Rates by Hispanic Ethnicity and Histology

AAAIR by Hispanic ethnicity and histology are shown in Table 13.

- The overall incidence rate for primary brain and other CNS tumors was 21.28 per 100,000 population among



* DIfference is statistically significant at the p<0.05 level
a. Rates per 100,000 and age−adjusted to the 2000 United States standard population. b. Defined using the United States Department of Agriculture's 2013 Rural Urban Continuum Codes (RUCCs, rural RUCC = 4−9; urban RUCC = 1−3).
Abbreviations: 95%CI= 95% confidence interval; AAAIR= Average annual age-adjusted incidence rate; IRR= Incidence rate ratio

Fig. 15 Average Annual Age-Adjusted Incidence Rates[a] with 95% Confidence Intervals of Selected Primary Brain and Other CNS Tumor Histologies by Urban Or Rural Location of Residence[b], CBTRUS Statistical Report: US Cancer Statistics - NPCR and SEER, 2012–2016

Hispanics and 23.84 per 100,000 population among non-Hispanics.
- Tumors of the pituitary, lymphoma, and other hematopoietic neoplasms were the only histologies that were higher in Hispanics than in non-Hispanics.

While there are multiple histologies, discussed above, where significant differences in incidence were observed by race and/or ethnicity, in **most cases the actual difference in incidence rates is small and may not be biologically significant.**

Incidence and Distribution of Primary Brain and Other CNS Tumors in Childhood and Adolescence by Site, Histology, Sex, and Age

Distribution of tumors by site and histology in children and adolescents (age 0–19 years)

The distribution of brain and other CNS tumors for children and adolescents age 0–19 years by site is shown in Figure 17A. Brain and other CNS tumors are the most common form of solid tumors in children[50] and account for the majority of cancer mortality in this age group.[51] About 6.1% of the reported brain and other CNS tumors during 2012–2016 occurred in children and adolescents age 0–19 years.

- The largest percentages of tumors in childhood and adolescence were located in the pituitary and craniopharyngeal duct (16.5%).
- Frontal, temporal, parietal, and occipital lobes of the brain accounted for 5.9%, 6.8%, 2.7%, and 1.2% of all brain and other CNS tumors in childhood and adolescence, respectively.
- Cerebrum, ventricle, brain stem, and cerebellum tumors accounted for 5.2%, 5.3%, 10.9%, and 12.9% of all brain and other CNS tumors in childhood and adolescence, respectively.
- Tumors of the meninges represented 2.9% of all tumors in childhood and adolescence.
- The cranial nerves and the spinal cord and cauda equina accounted for 7.3% and 4.9% of all brain and other CNS tumors in childhood and adolescence, respectively.

Figure 17B presents the most common brain and other CNS histologies in children and adolescents age 0–19 years.

- For children and adolescents age 0–19 years, pilocytic astrocytoma, glioma malignant, NOS, and embryonal tumors accounted for 15.0%, 7.6%, and 11.5%, respectively.
- Tumors of the pituitary were the most common **non-malignant** histology, and accounted for 13.0% of all tumors in this age group.
- Gliomas accounted for approximately 45.7% of tumors in children and adolescents age 0–19 years.
- Medulloblastoma accounted for 64.9% of all embryonal tumors in this age group.

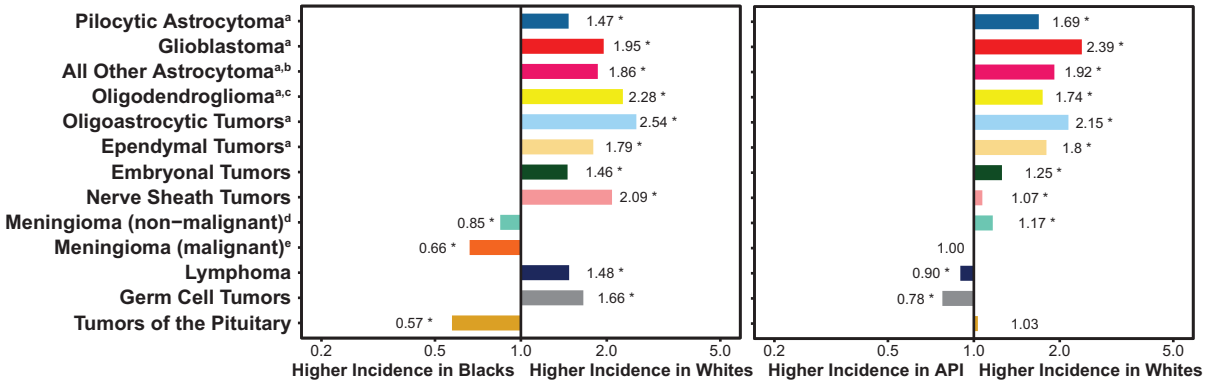
Distribution of tumors by site and histology in children (age 0–14 years)

The distribution of brain and other CNS tumors for children age 0–14 years by site is shown in Figure 18A. Approximately 4.3% of all reported tumors occurred in children age 0–14 years.

- Tumors of cerebellum (15.2%) comprised the largest proportion of tumors followed by the other brain (15.0%) and brain stem (13.3%).

Figure 18B presents the most common brain and other CNS histologies in children age 0–14 years.

- For children age 0–14 years, pilocytic astrocytoma, glioma malignant, NOS, and embryonal tumors accounted for 17.8%, 14.0%, and 13.1%, respectively.



* Incidence Rate is significantly different between groups at the p<0.05 level.
a. All or some of this histology are included in the CBTRUS definition of gliomas, including ICD–O–3 histology codes 9380–9384 and 9391–9460 (Table 3). b. ICD–O–3 Histology Codes: 9381, 9384, 9424, 9400, 9401, 9410, 9411, and 9420, all ICD–O–3 behavior codes. c. ICD–O–3 Histology and Behavior Codes: 9450/3, 9451/3, and 9460/3. d. ICD–O–3 Histology and Behavior Codes: 9530/0, 9530/1, 9531/0, 9532/0, 9533/0, 9534/0, 9537/0, 9538/1, and 9539/1. e. ICD–O–3 Histology and Behavior Codes: 9530/3, 9538/3, and 9539/3.

Fig. 16 Incidence Rate Ratios by Race (Whites:Blacks and Whites:Asian Or Pacific Islanders [API]) for Selected Selected Primary Brain and Other CNS Tumor Histologies, CBTRUS Statistical Report: US Cancer Statistics - NPCR and SEER, 2012–2016

- Gliomas accounted for approximately 51.6% of tumors in children age 0–14 years of embryonal tumors, medulloblastoma, ATRT, and PNET accounted for 64.1%, 15.9%, and 10.4%, respectively.

Distribution of tumors by site and histology in adolescents (age 15–19 years)

The distribution of these tumors by site is presented in Figure 19A. About 1.8% of all brain and other CNS tumors occurred in adolescents age 15–19 years for a total of 7,391 tumors diagnosed between 2012 and 2016 (Table 3).

- 33.5% of these tumors were diagnosed in the pituitary and craniopharyngeal duct.
- The frontal lobe, temporal lobe, occipital lobe, and parietal lobe accounted for 19.9% of tumors in this age group.

The distribution of brain and other CNS tumors in adolescents age 15–19 years by histology is presented in Figure 19B.

- The most common histology in adolescents was tumors of the pituitary (30.8%).
- Gliomas accounted for approximately 31.5% of tumors in adolescents. Of these gliomas, the histology pilocytic astrocytoma accounted for 8.3% of all tumors in this age group.

Incidence rates by histology, histology groupings, and sex in children and adolescents (age 0–19 years)

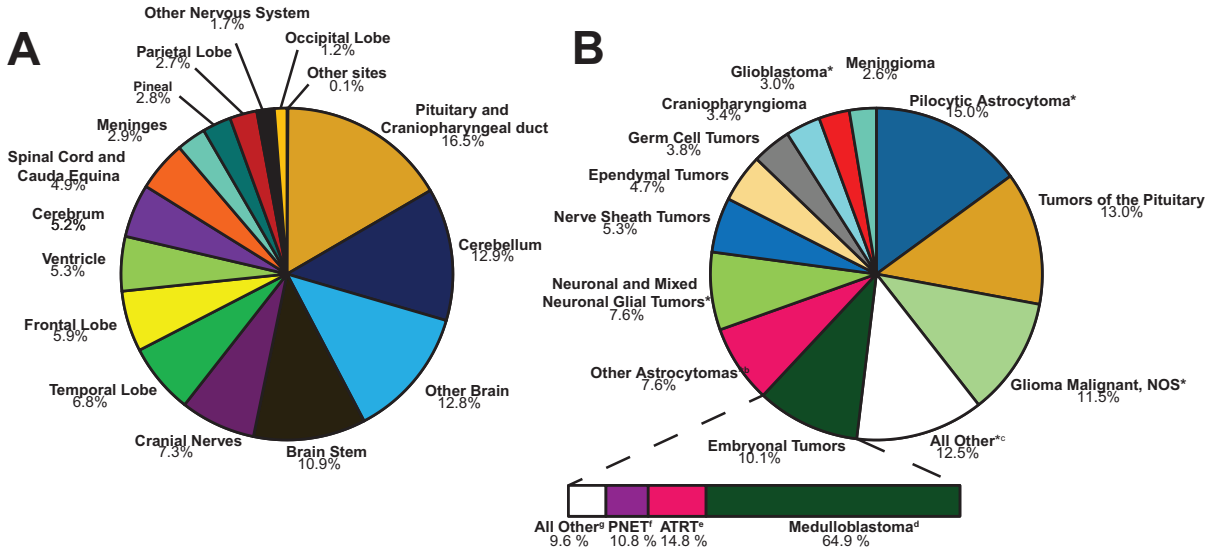
The incidence rates of the most common brain and other CNS tumors in children and adolescents by major histology grouping, histology, and sex are shown in Table 14.

- Average annual incidence rates were highest for tumors of neuroepithelial tissue (3.84 per 100,000 population). Among these tumors, the most common histologies were pilocytic astrocytoma (0.91 per 100,000 population), glioma malignant, NOS (0.70 per 100,000 population), and embryonal tumors (0.61 per 100,000 population).
- There were notable differences in incidence rates between males and females for ependymal tumors, embryonal tumors, germ cell tumors, and tumors of the pituitary.

Incidence rates by histology and race in children and adolescents (age 0–19 years)

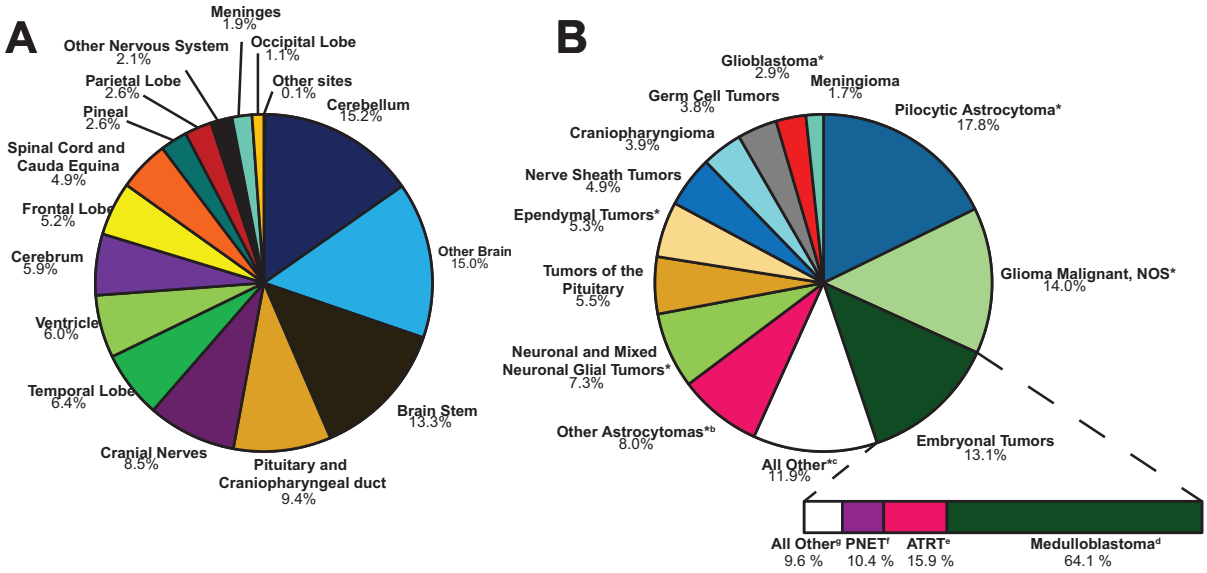
Table 15 shows incidence rates for brain and other CNS tumors by histology and race for children and adolescents age 0–19 years.

- Incidence rates were highest among White (6.29 per 100,000 population) compared to Blacks (4.71 per 100,000 population), AIAN (3.37 per 100,000 population), and API (5.17 per 100,000 population).



* All or some of this histology are included in the CBTRUS definition of gliomas, including ICD–O–3 histology codes 9380–9384 and 9391–9460 (Table 2). a. Percentages may not add up to 100% due to rounding. b. Includes diffuse astrocytoma, anaplastic astrocytoma, and unique astrocytoma variants (Table 2). c. Includes oligodendrogliomas and anaplastic oligodendrogliomas, choroid plexus tumors, other neuroepithelial tumors, tumors of the pineal region, other tumors of cranial and spinal nerves, mesenchymal tumors, primary melanocytic lesions, other neoplasms related to the meninges, other hematopoietic neoplasms, hemangioma, neoplasm unspecified, and all other (Table 2). d. ICD–O–3 Histology and Behavior Codes: 9470/3, 9471/3, 9472/3, and 9474/3. e. ICD–O–3 Histology and Behavior Code: 9473/3. f. ICD–O–3 Histology and Behavior Code: 9508/3. g. ICD–O–3 Histology and Behavior Codes: 8963/3, 9364/3, 9480/0, 9480/3, 9490/0, 9490/3, 9500/3, 9501/3, and 9502/3.
Abbreviations ATRT= Atypical teratoid/rhabdoid tumor; NOS= Not otherwise specified; PNET= Primitive neuroectodermal tumor

Fig. 17 Distribution[a] in Children and Adolescents (Age 0–19 Years) of Primary Brain and CNS Tumors (Five-Year Total = 24,931; Annual Average Cases = 4,986) by A) Site and B) Histology, CBTRUS Statistical Report: US Cancer Statistics - NPCR and SEER, 2012–2016



* All or some of this histology are included in the CBTRUS definition of gliomas, including ICD–O–3 histology codes 9380–9384 and 9391–9460 (Table 2). a. Percentages may not add up to 100% due to rounding. b. Includes diffuse astrocytoma, anaplastic astrocytoma, and unique astrocytoma variants (Table 2). c. Includes oligodendrogliomas and anaplastic oligodendrogliomas, choroid plexus tumors, other neuroepithelial tumors, tumors of the pineal region, other tumors of cranial and spinal nerves, mesenchymal tumors, primary melanocytic lesions, other neoplasms related to the meninges, other hematopoietic neoplasms, hemangioma, neoplasm unspecified, and all other (Table 2). d. ICD–O–3 istology and Behavior Codes 9470 3, 9471 3, 9472 3, and 9474e.3CD–O–3 istology and Behavior Code 9473 3. ICD–O–3 istology and Behavior Code 9508 3. g. ICD–O–3 istology and Behavior Codes 8963 3, 9364 3, 9480 0, 9480 3, 9490 0, 9490 3, 9500 3, 9501 3, and 9502 3.
Abbreviations ATRT Atypical teratoid rhabdoid tumor OS ot other ise specified P T Primitive neuroectodermal tumor

Fig. 18 Distribution[a] in Children (Age 0–14 Years) of Primary Brain and Other CNS Tumors (Five-Year Total = 17,540; Annual Average Cases = 3,508) by A) Site and B) Histology, CBTRUS Statistical Report: US Cancer Statistics - NPCR and SEER, 2012–2016

Incidence rates by histology and hispanic ethnicity in children and adolescents (age 0–19 years)

AAAIR of brain and other CNS tumors for children and adolescents age 0–19 years by Hispanic ethnicity are shown in Table 16.

- Incidence rates for non-Hispanics (6.35 per 100,000 population; 19,852 total tumors) were higher than those for Hispanics (5.14 per 100,000 population; 5,079 total tumors).
- The largest differences between non-Hispanics and Hispanics were in incidence rates of tumors of neuroepithelial tissue and tumors of cranial and spinal nerves.
- Incidence of most histologic types was higher among non-Hispanics than Hispanics, with the exception of tumors of the pituitary where incidence was 0.96 per 100,000 in Hispanics and 0.72 per 100,000 in non-Hispanics.

Incidence rates by age and histology in children and adolescents (age 0–19 years)

The detailed AAAIR for brain and other CNS tumors by histology for, children and adolescents age 0–19 years overall, and age-groups 0–4 years, 5–9 years, 10–14 years, and 15–19 years are shown in Table 6.

- Overall, incidence rates for age-groups 0–4 years (6.22 per 100,000 population) and 15–19 years (6.98 per 100,000 population) exceeded those observed in age-groups 5–9 years (5.38 per 100,000 population) and 10–14 years (5.65 per 100,000 population).
- Individual histology distributions varied substantially within these age-groups.
- Incidence rates of pilocytic astrocytoma, glioma malignant, NOS, ependymal tumors, choroid plexus tumors, and embryonal tumors decreased with increasing age.

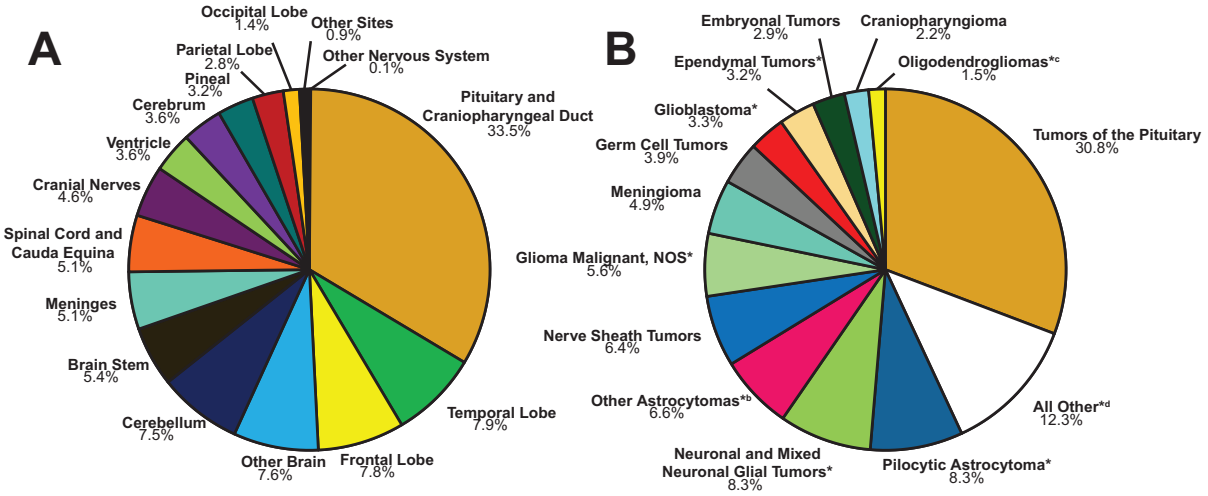
Incidence rates by histology defined by ICCC in children and adolescents (age 0–19 years)

Supplementary Table 10 presents the CBTRUS brain and other CNS tumor data for children and adolescents used for this report according to the ICCC grouping system for pediatric cancers (See Supplementary Table 1 for more additional information on the ICCC classification scheme).[15]

Estimated Numbers of Expected Cases, Mortality Rates, and Relative Survival

Estimated numbers of expected cases of all primary brain and other CNS tumors by state

Overall total rates presented are based on total malignant and non-malignant incidence, and presented stratified rates may not add up to these totals. Estimated numbers of cases are highly dependent on input data. Different patterns of incidence within strata can substantively affect the projected estimates, and strata-specific estimates may not



* All or some of this histology are included in the CBTRUS definition of gliomas, including ICD–O–3 histology codes 9380–9384 and 9391–9460 (Table 2). a. Percentages may not add up to 100% due to rounding. b. Includes diffuse astrocytoma, anaplastic astrocytoma, and unique astrocytoma variants (Table 2). c. Includes oligodendrogliomas and anaplastic oligodendrogliomas; d. includes choroid plexus tumors, other neuroepithelial tumors, tumors of the pineal region, other tumors of cranial and spinal nerves, mesenchymal tumors, primary melanocytic lesions, other neoplasms related to the meninges, other hematopoietic neoplasms, hemangioma, neoplasm unspecified, and all other (Table 2).

Fig. 19 Distribution[a] in Adolescents (Age 15–19 Years) of Primary Brain and Other CNS Tumors (Five-Year Total = 7,391; Annual Average Cases = 1,478) by A) Site and B) Histology, CBTRUS Statistical Report: US Cancer Statistics - NPCR and SEER, 2012–2016

equal the total estimate presented. Caution should be used when utilizing these estimates.

- The total number of new cases of **all** primary brain and other CNS tumors for all 50 states and the District of Columbia in 2019 is estimated to be 86,010, with 25,510 **malignant** and 60,490 **non-malignant** cases (Table 17).
- For 2020, the estimate is 87,240 new cases of **all** primary brain and other CNS tumors of which 25,800 and 61,430 are expected to be **malignant** and **non-malignant**, respectively.

Estimated number of expected cases of all primary brain and other CNS tumors by histology, histology grouping, and age

The estimated number of cases of **all** primary brain and other CNS tumors for 2019 and 2020 by histology and age are shown in Table 18.

- Meningiomas have the highest number of all estimated new cases, with 33,560 cases projected in 2019 and 34,210 in 2020.
- Glioblastoma has the highest number of cases of all **malignant** tumors, with 12,900 cases projected in 2019 and 13,140 in 2020.
- For 2019, the highest number of new cases is predicted in those age 65+ years, with 36,600 cases.
- For 2020, the highest number of new cases is estimated to be in those age 65+ years, with 37,500 cases.
- For 2019 and 2020, children age 0–14 years are estimated to have 3,540 and 3,540 new cases of primary brain and other CNS tumors each year, respectively.
- For 2019 and 2020, children age 0–19 years are estimated to have 4,750 and 4,760 new cases of primary brain and other CNS tumors each year, respectively.

Estimated mortality rates formalignant brain and other CNS tumors by state, sex, and urban/ rural residence

Table 19 and Figure 20 show average annual age-adjusted mortality rates for primary malignant brain and other CNS tumors in the US during 2012–2016 by state and sex. Average annual age-adjusted mortality rates for primary malignant brain and other CNS tumors by state and urban/ rural residence are shown in Supplementary Table 9.

- The aggregate total number of observed deaths was 79,718, for an average annual age-adjusted mortality rate of 4.42 per 100,000 population.
- There was considerable variation between individual states, which ranged from a low of 2.40 deaths per 100,000 population to a high of 5.44 deaths per 100,000 population. Rates may vary by state for multiple reasons, including demographic variation and procedures for deciding primary cause of death on a death certificate.
- Males had a higher mortality rate for **malignant** brain and other CNS tumors than females in the US population, with 5.38 per 100,000 population as compared to 3.59 per 100,000 population.
- Mortality rates for **malignant** brain and other CNS tumors were higher in rural areas (4.69 per 100,000) as compared to urban areas (4.37 per 100,000).
- There was considerable variation by state, where mortality rates in urban areas ranged from 2.40 per 100,000 population to 5.93 per 100,000 population, and mortality rates in rural areas ranged from 3.19 per 100,000 population to 5.51 per 100,000 population.

Relative survival rates for all brain and other CNS tumors by site and behavior

Relative survival estimates by site and behavior are presented in Table 20.

- The highest five-year survival among **malignant** tumors was for tumors occurring in the cranial nerves (93.4%).
- The lowest five-year survival among **malignant** tumors was for tumors of the parietal lobe (21.0%).

Survival rates for malignant brain and other CNS tumors by histology and age

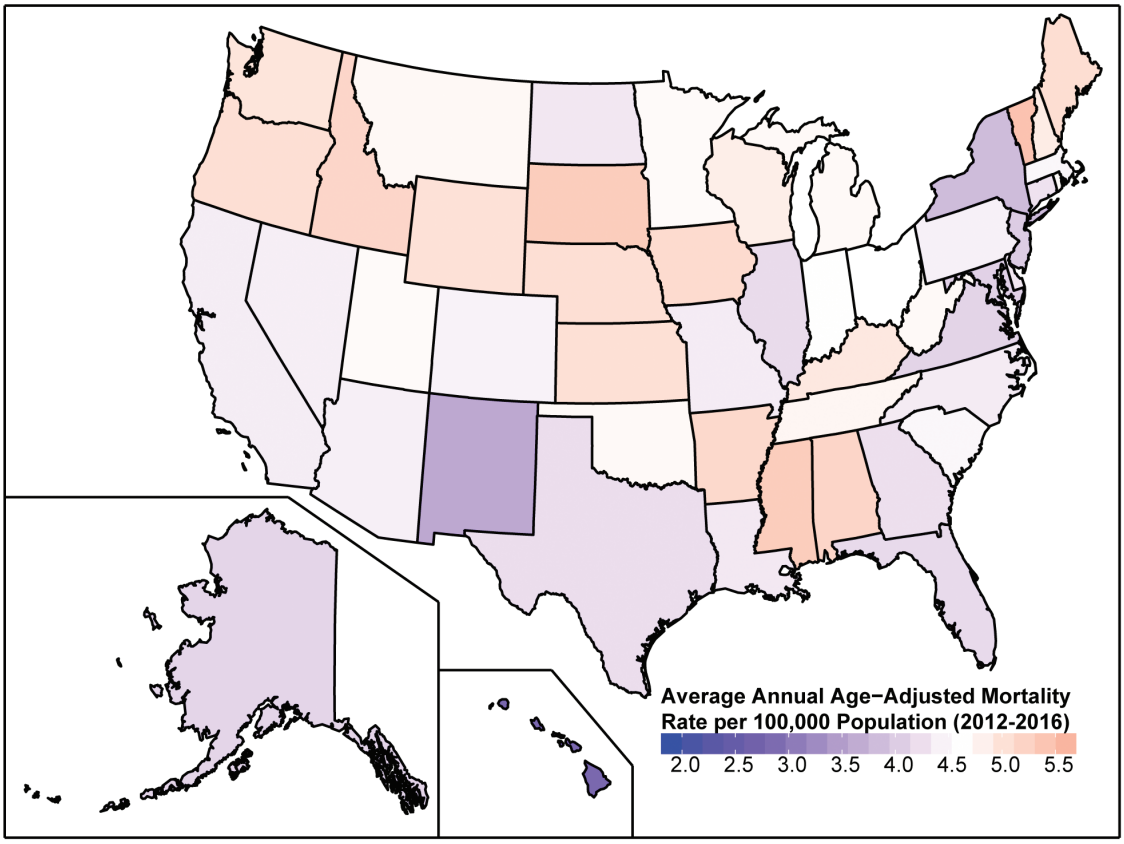
Survival estimates for malignant brain and other CNS tumors by histology and age at diagnosis are presented in Tables 21, 22. Histology-specific rates are presented for the CBTRUS histology groupings which contain a substantial number of incident malignant tumors.

- The estimated five- and ten-year relative survival rates for all **malignant** brain and other CNS tumors were 35.8% and 30.8%, respectively.
- There was large variation in survival estimates depending upon tumor histology; five-year survival rates were 94.4% for pilocytic astrocytoma but are 6.8% for glioblastoma.
- Survival generally decreased with older age at diagnosis; children and young adults generally had better survival outcomes for most histologies.

Survival rates for non-malignant brain and other CNS tumors by histology and age

Survival estimates for non-malignant brain and other CNS tumors by histology and age at diagnosis are presented in Table 23, 24. Histology-specific rates are presented for the CBTRUS histology groupings which contain a substantial number of incident non-malignant tumors.

- Overall, 91.5% of persons with **non-malignant** tumor survived five years after diagnosis.
- Five-year survival was highest in nerve sheath tumors and embryonal tumors, which had five-year relative survival of 99.3% and 98.1%, respectively.
- Five-year survival was lowest in primary melanocytic lesions, craniopharyngioma, and meningioma, which had



a. Rates per 100,000 and age–adjusted to the 2000 United States standard population.

Fig. 20 Average Annual Age-Adjusted Mortality Rates[a] for Malignant Primary Brain and Other CNS Tumors by Central Cancer Registry, CBTRUS Statistical Report: NVSS, 2012–2016

five-year relative survival of 63.3%, 86.1% and 88.0%, respectively.
- Overall, five-year survival in adolescents and young adults was highest (98.1%) compared to children (97.2%) and adults (90.1%).

Survival rates for malignant brain and other CNS tumors by urban/rural residence

Survival estimates for malignant and non-malignant brain and other CNS tumors are shown by urban/rural residence and selected histologies in Supplementary Table 11 and Supplementary Table 12. Overall, one-, five-, and ten-year survival were higher in urban areas as compared to rural areas.

Descriptive Summary of Spinal Cord Tumors

Although spinal cord tumors account for a relatively small percentage of brain and other CNS tumors, they result in significant morbidity. The most common histologies found in the spinal cord, spinal meninges, and cauda equina are presented in Figure 21 for both children (age 0–19 years, Fig. 21A) and adults (age 20+ years, Fig. 21B).

- The predominant histology group for those age 0–19 years was ependymal tumors (20.6%) followed by nerve sheath tumors (17.8%).
- Tumors of meninges (38.8%) accounted for the largest proportion of spinal cord tumors among those age 20 years and older.
- Five-year survival after diagnosis with a **malignant** tumor of the spinal cord and cauda equina was 82.0%, with a ten-year relative survival of 78.7% (Table 19).

Descriptive Summary of Meningioma, Glioblastoma, and Embryonal Tumors

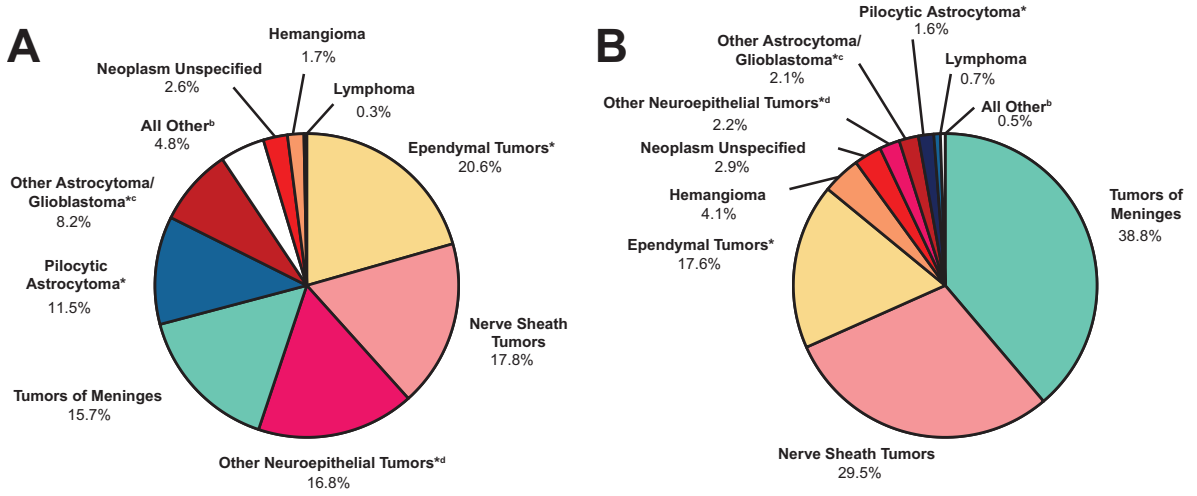
The data in the CBTRUS Statistical Report 2012–2016 were synthesized to describe three of the most common histologic types: meningioma and glioblastoma for adults and embryonal tumors for children and adolescents.

Meningioma

- **Meningioma was the most frequently reported brain and other CNS tumor, accounting for 37.6% of tumors overall** (Fig. 7B). Most meningiomas (80.3%) were located in the cerebral meninges, 4.2% were located in the spinal meninges, and approximately 14.7% did not have a specific meningeal site listed.
- **Non-malignant** meningioma with ICD-O-3 behavior codes /0 (benign) or /1 (uncertain) accounted for 97.7% of meningiomas reported to CBTRUS (Table 3).
- Overall, 40% of meningioma diagnoses were histologically confirmed (Table 11), and this proportion varied by behavior (39.5% in **non-malignant** meningioma and 79.0% in **malignant** meningioma)
- Of meningioma with documented WHO grade (79.3%, Table 11), 80.5% were WHO grade I, 17.7% were WHO grade II, and 1.7% were WHO grade III.
- Meningioma was most common in adults age 65 years and older (Table 7), and one of the least common in children age 0–14 years (Table 5).
- Incidence of meningioma increased with age, with a dramatic increase after age 65 years. Even among the population age 85 years and older, these rates continued to be high (Table 7).
- Non-malignant meningiomas overall were 2.32 times more common in females compared to males (Fig. 13). Incidence rate ratios were lowest between males and females in persons <20 years old (where incidence rates for males and females were approximately equal), and highest from 35–44, where incidence rates were 3.28 times higher in females (Supplementary Figure 15).
- Incidence of meningioma was significantly higher in Blacks than in Whites (Fig. 16).
- Ten-year relative survival for **malignant** meningioma was 61.7% (Table 21). Age had a large effect on survival after diagnosis with **malignant** meningioma: 10-year relative survival was 76.8% for the population age 20–44 years, and 39.5% for age 75+ years (Table 22).
- Ten-year relative survival for **non-malignant** meningioma was 83.7% (Table 23). Age had a large effect on survival after diagnosis with **non-malignant** meningioma: 10-year relative survival was 89.9% in children (age 0–14 years), 94.8% in AYA (age 15–39 years), and 82.8% in adults (age 40+ years old).
- Site of meningioma had an effect on survival after diagnosis with meningioma. **For non-malignant** meningioma, 10-year relative survival was 83.2% for tumors in the cerebral meninges, but 95.6% for tumors in the spinal meninges.
- Survival was also higher in **malignant** meningioma for spinal tumors, where 10-year relative survival was 73.4%, as compared to 55.7% for tumors in the cerebral meninges (**Supplementary Figure 16**).

Glioblastoma

- **Glioblastoma was the third most frequently reported CNS histology and the most common malignant tumor overall** (Fig. 7B **and** Fig. 8B).
- Glioblastoma accounted for 14.6% of **all** primary brain and other CNS tumors (Fig. 7B), 48.3% of primary **malignant** brain tumors (Fig. 8B) and 57.3% of **all gliomas** (Fig. 10B)
- Glioblastoma was more common in older adults (Table 7) and was less common in children (Table 6); these tumors comprised 3.0% of all brain and other CNS tumors reported among age 0–19 years.
- Incidence of glioblastoma increased with age, with rates highest in individuals age 75 to 84 years (Table 7).
- Glioblastoma was 1.58 times more common in males compared to females (Fig. 13).
- Glioblastoma was 1.95 times higher among Whites compared to Blacks (Fig. 16).
- Relative survival estimates for glioblastoma were quite low; 6.8% of patients survived five years post-diagnosis (Table 21). These survival estimates were somewhat higher for the small number of patients who were diagnosed under age 20 years (Table 22).



* All or some of this histology are included in the CBTRUS definition of gliomas, including ICD–O–3 histology codes 9380–9384, 9391–9460 (Table 2). a. Percentages may not add up to 100% due to rounding. b. Includes embryonal tumors, other tumors of cranial and spinal nerves, other hematopoietic neoplasms, germ cell tumors, neoplasm unspecified, and all other (Table 2). c. Includes diffuse astrocytoma, anaplastic astrocytoma, unique astrocytoma variants and glioblastoma (Table 2). d. Includes oligodendroglioma, anaplastic oligodendroglioma, oligoastrocytic tumors, glioma malignant, NOS, choroid plexus tumors, other neuroepithelial tumors, and neuronal and mixed neuronal–glial tumors (Table 2).

Fig. 21 Distribution[a] of Primary Spinal Cord, Spinal Meninges, and Cauda Equina Tumors by Histology in A) Children and Adolescents (Age 0–19 Years, Five-Year Total = 1,322; Annual Average Cases = 264) and B) Adults (Age 20+ Years, Five-Year Total = 18,184; Annual Average Cases = 3,637), CBTRUS Statistical Report: US Cancer Statistics - NPCR and SEER, 2012–2016

Embryonal Tumors

- **Embryonal tumors were the most frequently reported brain and other CNS tumor histology grouping in children age 0–4 years, and the fifth most common tumor type overall in children and adolescents age 0–19 years** (Table 6, Fig. 17B).
- Embryonal tumors within the CBTRUS histologic grouping scheme include multiple different histologies: medulloblastoma, PNET, ATRT, and several other rare histologies (Table 2).
- Embryonal tumors accounted for 13.1% of all primary brain and other CNS tumors in children age 0–14 years (Fig. 18B), 10.1% of tumors in children and adolescents age 0–19 years (Fig. 17B), and 0.9% of tumors diagnosed overall (Fig. 7B).
- Incidence of medulloblastoma decreased with increasing age after 9 years old. Incidence was 0.54 per 100,000 population, 0.59 per 100,000 population, 0.33 per 100,000 population, and 0.15 per 100,000 population in children age 0–4, 5–9, 10–14 years, and adolescents age groups 15–19 years, respectively (Table 6).
- Incidence of PNET was 0.15 per 100,000 population, 0.05 per 100,000 population, 0.04 per 100,000 population, and 0.03 per 100,000 population in children age 0–4, 5–9, 10–14 years, and adolescents age 15–19 years, respectively (Table 6).
- Incidence of ATRT was 0.32 per 100,000 population and 0.03 per 100,000 population in children age 0–4 and 5–9 years, respectively. There were too few of these cases in older age groups to report (Table 6).
- Relative survival estimates for embryonal tumors were low but varied significantly by histology. 10-year survival was 66.1% for medulloblastoma, 30.0% for PNET, and 37.0% for ATRT (Table 21).
- Embryonal tumors were more common in males than females (Table 3, Table 14). This difference was greatest in medulloblastoma, which occurred 1.66 times as frequently in males 0–14 years as compared to females in this age group (Supplementary Figure 17). Incidence of ATRT and PNET in children age 0–14 years were not significantly different between males and females.

Descriptive Summary of Adolescent and Young Adult (AYA) Primary Brain and Other CNS Tumors (Age 15–39 Years)

Brain and other CNS tumors are less common in AYA (age 15–39 years)[52] compared to older adults (Table 4). **These tumors are the third most commonly occurring cancer in persons age 15–39 years in the US, and the third most common cause of cancer death.**[53]

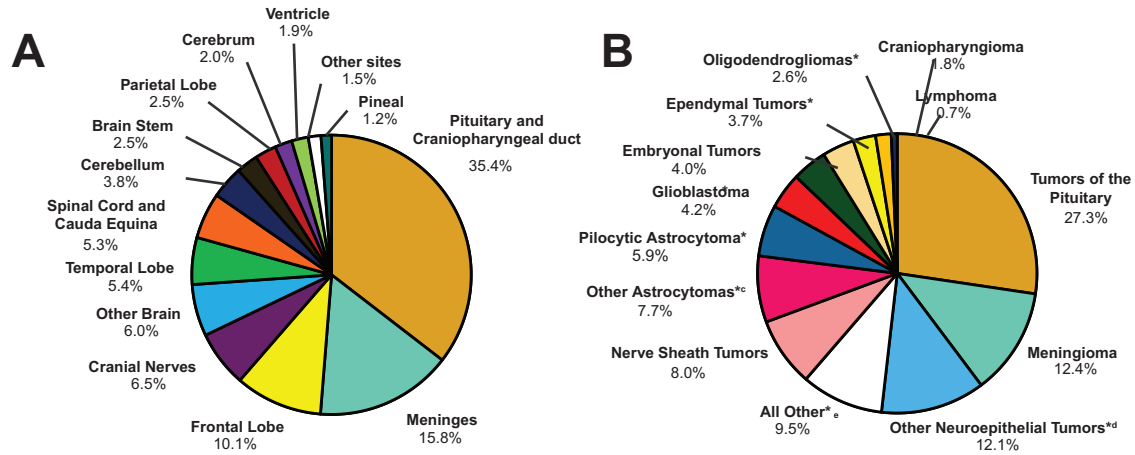
- There were 59,515 primary brain and other CNS tumors diagnosed in AYA between 2012 and 2016, representing 14.7% of all brain and other CNS tumors (Fig. 22).
- The overall incidence rate in this age group was 11.40 per 100,000 population (Table 5). Incidence of **malignant** tumors was 3.23 per 100,000, and incidence of **non-malignant** tumors was 8.17 per 100,000 (Table 5).
- Tumors of the sellar region had the highest incidence (3.95 per 100,000 population), followed by tumors of the neuroepithelial tissue (3.46 per 100,000 population) (Table 2).
- The most common histology in AYA was tumors of the pituitary (3.82 per 100,000 population), followed by meningioma (1.86 per 100,000 population) and nerve sheath tumors (1.03 per 100,000 population) (Table 5).

- The majority of AYA brain and other CNS tumors occurred in the pituitary and craniopharyngeal duct (35.4%), followed by the meninges (15.8%) (Fig. 22A).
- 18.7% of tumors diagnosed in AYA were located within the frontal, temporal, parietal, and occipital lobes of the brain combined (Figure 22A, occipital percentage not shown in figure due to low count).
- Cerebrum, ventricle, cerebellum, and brain stem tumors combined accounted for 10.2% of all AYA tumors (Fig. 22A).
- The predominately **non-malignant** tumors of the pituitary (27.3%), meningioma (12.4%), and nerve sheath (8.0%) represented over half of all brain and other CNS tumors diagnosed in AYA (Fig. 22B).
- Glioma accounted for approximately 26.0% of **all** brain and other CNS tumors in AYA, and about 82.4% of all **malignant** tumors (Fig. 22B).
- AYA are estimated to have 12,030 new primary brain and other CNS tumors in 2019 and 12,090 in 2020 (Table 18).
- AYA had higher rates of relative survival than adults greater than 40 years old for all histologic types. Though 1-year relative survival for most tumor types was higher for AYA than children, 5- and 10-year survival were usually higher for children as compared to AYA (Table 24).

Descriptive Summary of Time Trends in Primary Brain and Other CNS Tumors

Time trends in cancer incidence rates are an important measure of the changing burden of cancer in a population over time. **Many factors may lead to fluctuations in rates over time and all of these must be considered when interpreting time trends results.** When assessing trends in incidence over time it is critical to use the most recent data available, as delay in reporting may cause small fluctuations in incidence. Time trends analysis methods are used to estimate if the APC is significantly different from 0% (meaning no change in incidence from year to year). **In addition to assessing statistical significance of changes in incidence over time, the size of this change must also be considered because with datasets as large as CBTRUS very small fluctuations in incidence over time may be statistically significant but not truly represent a large change in proportion of individuals over time.**

Incidence rates of cancer overall, and many specific cancer histologies, have decreased over time.[54] Overall, changes in incidence rates of **all primary** brain and other CNS tumors between 2000 and 2016 (limited to 2004–2016 for non-malignant tumors) have been small. As stated previously, there are many things that can affect incidence rates over time that are not related to 'true' changes in incidence of these tumors such as demographic changes, changes in histologic classification, and changes in cancer registration procedures. The latetr is especially applicable to the collection of non-malignant brain and other CNS tumors, which have only been collected since 2004 in accordance with Public Law 107–260. Though these tumors are included in cancer collection, some surveillance reports do not include these tumors under their brain and other CNS tumors classification, but restrict reporting to malignant CNS tumors, including cancer trends. Incidence of non-malignant brain and CNS tumors increased substantially during the first years of collection as completeness of reporting improved, and CBTRUS has previously reported that there was increasing incidence of non-malignant brain tumors from 2004 to 2006.[55,56]



* All or some of this histology are included in the CBTRUS definition of gliomas, including ICD-O-3 histology codes 9380-9384, 9391-9460 (Table 2). a. Percentages may not add up to 100% due to rounding. b. Adolescents and Young Adults (AYA), as defined by the National Cancer Institute, see: https://www.cancer.gov/types/aya. c. Includes diffuse astrocytoma, anaplastic astrocytoma, and unique astrocytoma variants (Table 2). d. Includes oligoastrocytic tumors, glioma malignant, NOS, choroid plexus tumors, other neuroepithelial tumors, neuronal and mixed neuronal-glial tumors, and tumors of the pineal region (Table 2). e. Includes other tumors of cranial and spinal nerves, mesenchymal tumors, primary melanocytic lesions, other neoplasms related to the meninges, hemangioma, neoplasm unspecified, and all other (Table 2).

Fig. 22 Distribution[a] in Adolescents and Young Adults[b] (Age 15–39 Years) of All Primary Brain and Other CNS Tumors (Five-Year Total = 59,515; Annual Average Cases = 11,903) by A) Site and B) Histology, CBTRUS Statistical Report: US Cancer Statistics - NPCR and SEER, 2012–2016

All malignant brain and other CNS tumors

- **Overall, there was a small but statistically significant decrease in incidence of malignant brain and other CNS tumors from 2000–2016 (APC = -0.4% [95% CI: -0.6%, -0.2%]).**
- From 2008–2016, there was a slight decrease in overall incidence (APC = -0.9% [95% CI: -1.2%, -0.7%], Fig. 23, Supplementary Table 13). **These changes likely represent random variation or changes in underlying demographics rather than a true change in incidence of malignant brain tumors.**
- There was a small but statistically significant increase in incidence in children (age 0–14 years, APC = 0.6% [95% CI: 0.3%, 0.9%], Fig. 23), a small but statistically significant decrease in AYA (age 15–39 years, APC = -0.4% [95% CI: -0.6%, -0.2%], Fig. 23) from 2000–2016, and a small but statistically significant decrease in older adults from 2008–2016 (age 40+ years, APC = -1.1% [95% CI: -1.5%, -0.8%], Fig. 23).

Glioma

- **Overall, there was no significant change in incidence of glioma from 2000–2016.**
- There was a slight increase in incidence between 2000 and 2007 (APC = 0.9% [95% CI: 0.5%, 1.3%], Fig. 24), followed by a small but significant decrease in incidence from 2008–2016 (APC = -0.8% [95% CI: -1.2%, -0.4%], Fig. 24).
- There was a significant increase in incidence in children (age 0–14 years, APC = 1.9% [95% CI: 1.4%, 2.4%]) from 2000–2013, and a significant increase in incidence in AYA from 2000–2006 (age 15–39 years, APC = 2.3% [95% CI: 0.7%, 3.8%], Fig. 24).
- Incidence in older adults (age 40+ years) was relatively stable: there was a statistically significant increase from 2000–2007 (APC = 0.6%, [95% CI: 0.2%, 1.1%]), followed by a statistically significant decrease from 2007–2016 (APC = -0.8% [95% CI: -1.1%, -0.6%], Fig. 24).
- There was a small but significant increase in incidence of glioblastoma from 2000–2007 (APC = 1.0 [95% CI: 0.2%, 1.2%]), with no significant change between 2007 and 2016 (Fig. 24, Supplementary Table 13).
- **Despite finding statistically significant variation, this likely represents random variation or changes in underlying demographics rather than a true change in incidence of glioma.**

Malignant Meningioma

- There was a significant decrease in incidence between 2000 and 2016 (APC = -4.5% [95% CI: -5.3%, -3.7%], Supplementary Table 13).
- **Changes were made to histological classification of meningioma in both the 2000 and 2007 revisions of the WHO classification, and gradual uptake of these classification changes may result in changing incidence of these tumors.**[57]

All non-malignant brain and other CNS tumors

- **Overall, there was a statistically significant increase in incidence of non-malignant brain and other CNS tumors from 2004–2018 (APC = 2.2% [95% CI: 1.3%, 3.0%]).**
- There was a significant increase in incidence of non-malignant brain tumors from 2004–2009 (APC = 5.2% [95% CI: 3.3%, 7.2%], Fig. 23, Supplementary Table 14), and no significant change between 2009 and 2016.
- There was a small but statistically significant increase in incidence of these tumors in children (2004–2016, APC = 2.1% [95% CI: 1.4%, 2.9%], Fig. 23), in AYA (2004–2009, APC = 6.4% [95% CI: 3.9%, 9.0%], Fig. 23), and older adults (2004–2009, APC = 5.0% [95% CI: 3.1%, 6.9%], Fig. 23).
- From 2012–2016, only 44.1% of non-malignant brain and other CNS tumors were histologically confirmed (Table 11). When analysis was limited to histologically confirmed tumors only, there was a small but significant increase in incidence of non-malignant brain and other CNS tumors from 2004–2009 (APC = 1.6% [95% CI: 0.5%, 2.7%]), followed by a small but significant decrease from 2009–2016 (APC = -1.2% [95% CI: -1.8%, -0.5%]).
- There was a statistically significant increase in incidence of radiographically confirmed non-malignant tumors from 2004–2009 (APC = 9.6% [95% CI: 6.5%, 12.8%]), with no significant change from 2009–2016.
- **The increases in incidence in the non-malignant tumors are partially attributable to improved collection of radiographically diagnosed cases as well as improvement in collection of non-malignant cases in general over time.**

Non-malignant meningioma

- There was a significant increase of non-malignant meningioma between 2004 and 2009 (APC = 5.0% [95% CI: 3.5%, 6.5%], Fig. 25A), but there was no significant change after 2009.
- From 2012–2016, only 39.5% of non-malignant meningiomas were histologically confirmed (Table 11). When analysis was limited to histologically confirmed cases, there was a slight increase in incidence from 2004–2009 (APC = 1.1% [95% CI: 0.1%, 2.1%]) and there was a slight decrease (APC = -1.5% [95% CI: -2.1%, -1.0%]) from 2009–2016.
- There was a significant increase in incidence of radiographically diagnosed cases from 2004–2009 (APC = 8.9% [95% CI: 6.2%, 11.6%]), with no significant change from 2009 to 2016.
- **The increases in incidence in these non-malignant tumors are partially attributable to improved collection of radiographically diagnosed cases as well as improvement in collection of non-malignant cases in general over time.**

Non-Malignant nerve sheath tumors

- There was a small but significant increase in the incidence of non-malignant nerve sheath tumors between 2004 and 2016 (APC = 1.0% [95% CI: 0.4%, 1.7%], Fig. 25A).
- From 2012–2016, only 50.4% of non-malignant nerve sheath tumors were histologically confirmed (Table 11). When analysis was limited to histologically confirmed cases only, there was no significant change in incidence (APC = -0.1% [95% CI: -0.8%, 0.5%]) from 2004–2016.

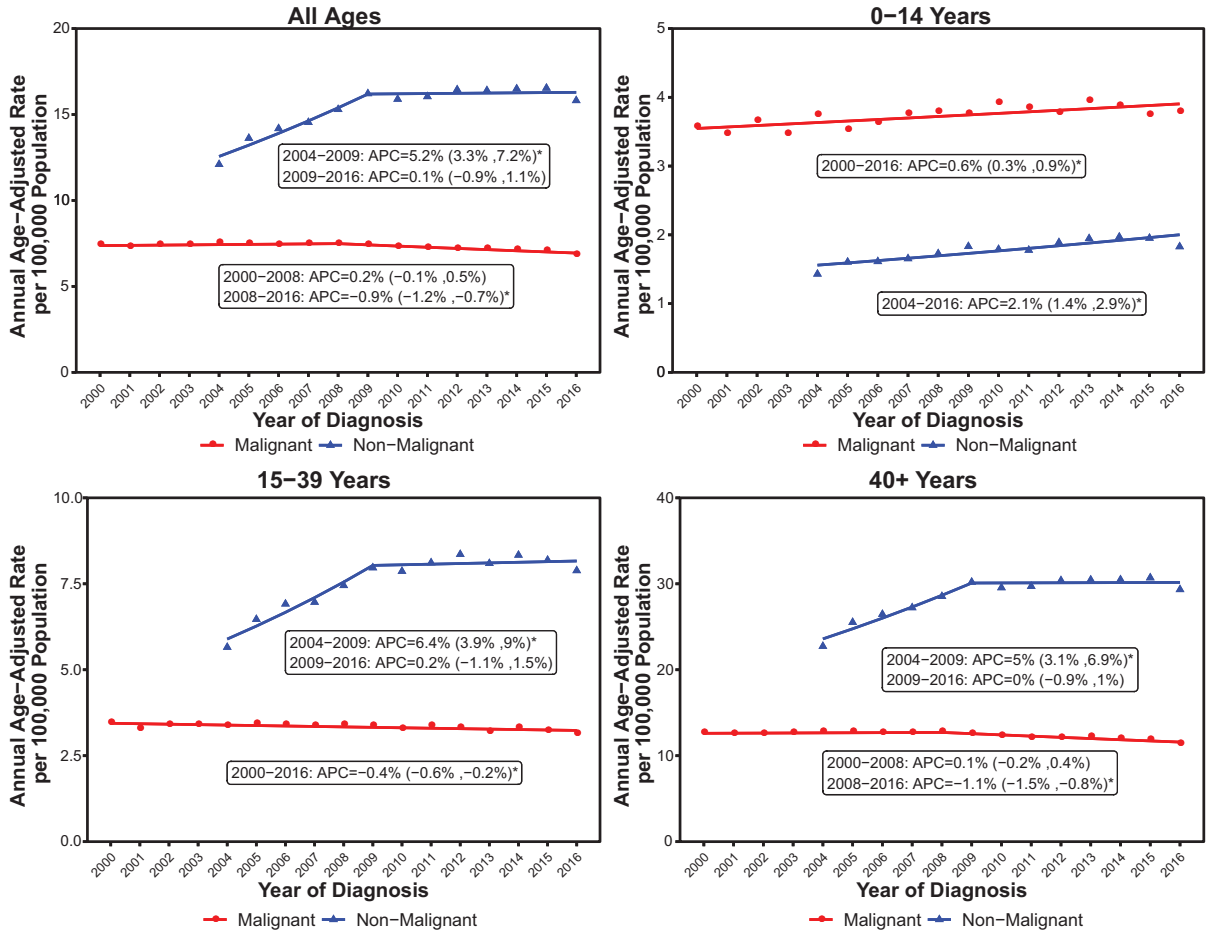


Fig. 23 Annual Age-Adjusted Incidence Rates of Primary Brain and Other CNS Tumors, and Incidence Trends by Behavior and Age Group, CBTRUS Statistical Report: US Cancer Statistics - NPCR and SEER, 2000–2016 (Varying)

- There was a significant increase in incidence of radiographically diagnosed tumors between 2004 and 2007 (APC = 8.8%, [95% CI: 3.3%, 14.6%]) and 2007 to 2013 (APC = 2.7 [95% CI: 0.8%, 1.8%]).
- **The increases in incidence in these non-malignant tumors are partially attributable to improved collection of radiographically diagnosed cases as well as improvement in collection of non-malignant cases in general over time.**

Non-Malignant tumors of the pituitary

- There was a significant increase in non-malignant tumors of the pituitary from 2004–2008 (APC = 7.7% [95% CI: 4.9%, 10.7%], Fig. 25A), but no significant change in incidence from 2008–2016.
- From 2012–2016, only 46.6% of non-malignant tumors of the pituitary were histologically confirmed (Table 11). When analysis was limited to histologically confirmed tumors only, there was a significant increase (APC = 4.5% [95% CI: 3.3%, 5.8%]) from 2004–2009, followed by a small but significant decrease from 2009–2016 (APC = -1.8% [95% CI: -2.4%, -1.1%]).
- There was a significant increase in incidence of radiographically diagnosed tumors of the pituitary from 2004–2008 (APC = 11.4% [95% CI: 6.4%, 16.7%]) and 2008–2012 (APC = 6.7% [95% CI: 0.6%, 13.2%]), with no significant change in incidence from 2012–2016.
- **The increases in incidence in these non-malignant tumors are partially attributable to improved collection of radiographically diagnosed cases as well as improvement in collection of non-malignant cases in general over time.**

Prevalence of Primary Malignant Brain and Other CNS Tumors

Prevalence is an estimate of the total number of individuals with a disease who currently exist within a population, as compared to incidence, which is a calculation based on **new diagnoses** only. These calculations take into account not only the number of new cases being

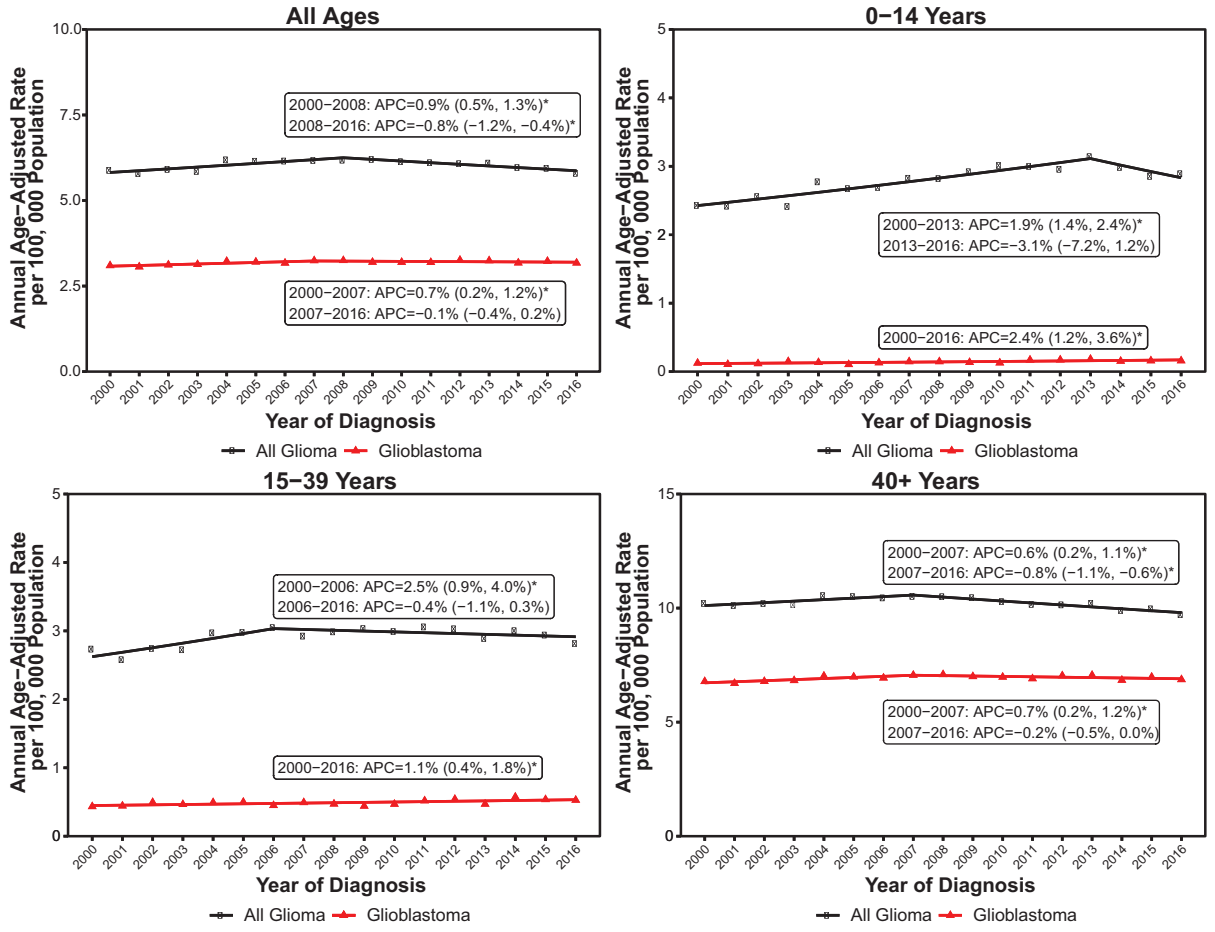


Fig. 24 Annual Age-Adjusted Incidence Rates of Primary Brain and Other CNS Gliomas and Glioblastoma, and Incidence Trends by Age Group, CBTRUS Statistical Report: US Cancer Statistics - NPCR and SEER, 2000–2016

diagnosed, but also the length of time that individuals survive after diagnosis. CBTRUS previously estimated the 2010 point prevalence rate for all primary malignant brain and CNS tumors to be 47.6 per 100,000 population, or a total of 103,634 cases.[58] Prevalence in children (0–14 years old) was estimated to be 22.31 per 100,000 population (13,657 cases), while prevalence in AYA (15–39 years old) was estimated to be 48.49 per 100,000 (31,299 cases). These ages represent **age at time of prevalence calculation** and not the age at which individuals were diagnosed. Please refer to Zhang, et al[58] for more details.

CBTRUS also previously estimated the 2014 prevalence of selected adult malignant brain tumor histologies. Glioblastoma had the highest prevalence, at 9.23 per 100,000 population (23,327 cases), followed by diffuse astrocytoma (4.68 per 100,000 population; 10,868 cases), and oligodendroglioma (3.57 per 100,000 population; 8,217 cases). Please refer to Gittleman, et al[59] for more details, including sex-, race-, and ethnicity-specific prevalence estimates.

Years of Life Lost due to Primary Malignant Brain and Other CNS Tumors in the United States

Years of potential life lost (YPLL) are an estimate of the amount that an individual's life has been shortened by premature death due to cancer. Malignant brain tumors cause an average of 20 YPLL for individuals diagnosed as adults, which exceeds most common cancers.[60] Among children 0–19 years old, brain and other CNS tumors represent the largest cause of YPLL due to cancer, with a mean YPLL of ~80 years.[51] Please refer to de Blank, et al and Rouse, et al for more details.[51,60]

Lifetime Risk of Primary Malignant Brain and Other CNS Tumors

From birth, a person in the US has a 0.62% chance of ever being diagnosed with a primary malignant brain and other CNS tumor (excluding lymphomas, leukemias, tumors of the pituitary and pineal glands, and olfactory tumors of the

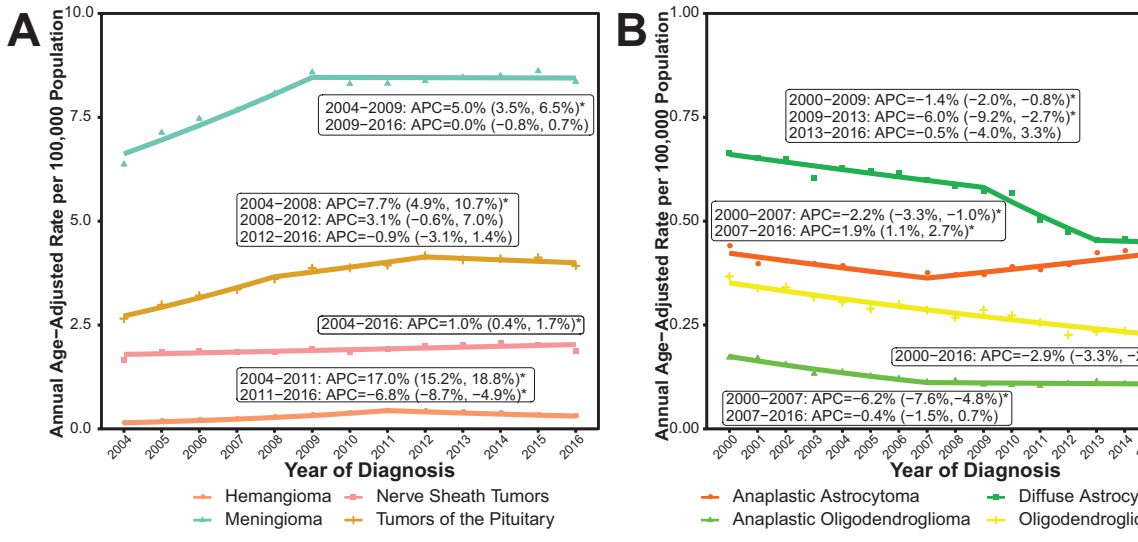


Fig. 25 Annual Age-Adjusted Incidence Rates of Selected Primary Brain and Other CNS Tumors, and Incidence Trends by Behavior and Histology, CBTRUS Statistical Report: US Cancer Statistics - NPCR and SEER, 2000–2016 (Varying).

nasal cavity) and a 0.48% chance of dying from a primary **malignant** brain/other CNS tumor.[61–64]

- For males (all races), the risk of developing and the risk of dying from a primary **malignant** brain and other CNS tumor is 0.69% and 0.54%, respectively.
- For females (all races), the risk of developing and the risk of dying from a primary **malignant** brain and other CNS tumor is 0.55% and 0.42%, respectively.
- For White non-Hispanics (both sexes), the risk of developing and the risk of dying from a primary **malignant** brain and other CNS tumor is 0.72% and 0.55%, respectively.
- For White Hispanics (both sexes), the risk of developing and the risk of dying from a primary **malignant** brain and other CNS tumor is 0.55% and 0.40%, respectively.
- For Blacks (both sexes), the risk of developing and the risk of dying from a primary **malignant** brain and other CNS tumor is 0.33% and 0.26%, respectively.
- For API (both sexes), the risk of developing and the risk of dying from a primary **malignant** brain and other CNS tumor is 0.41% and 0.32%, respectively.

Risk Factors for Primary Brain and Other CNS Tumors

Many environmental and behavioral risk factors have been investigated for primary brain and other CNS tumors. The only well-validated factors are increased risk for these tumors (particularly meningiomas) with exposure to ionizing radiation[65] (the type of radiation generated by atomic bombs, therapeutic radiation treatment, and some forms of medical imaging) and decreased risk for these tumors (particularly glioma) in persons with a history of allergy or other atopic disease[66] (including eczema, psoriasis, and asthma). Having a first-degree family member (including parents, children, and full siblings) that has been diagnosed with a brain tumor has been shown to increase risk approximately two-fold.[67–71] Several recent review articles have elaborated on the current state of risk factor research in primary brain and other CNS tumors.[72–75]

Biomarkers for Primary Brain and Other CNS Tumors

Primary brain and other CNS tumors are a highly heterogeneous group of diseases, and characterization of unique tumor histologies within this group has been refined over time. The development of technologies for characterizing DNA, RNA, and DNA methylation has led to the discovery of several factors (known as 'biomarkers') that can be used to more accurately classify these tumors than histologic appearance alone. See Table 25 for a brief overview of selected biomarkers for primary brain and other CNS tumors, as well as a more in depth discussion in Scheie, et al[76] and Velázquez Vega and Brat,[77] as well as in Guerreiro Stucklin, et al.[78] for pediatric biomarkers specifically.

Gliomas, as the most common malignant primary brain and other CNS tumor type, have been subject to the greatest amount of investigation. A recent review has described in detail the current state of glioma biomarker research.[93] One of the earliest discoveries in glioma biomarkers was that oligodendroglioma often had large deletions (missing parts of the chromosome, also known as loss of heterozygosity) in the short arm of chromosome 1 (1p) and the long arm of chromosome 19 (19q).[79] In general, these deletions significantly predict positive response to chemotherapy and radiation treatment in oligodendroglioma

and anaplastic oligodendroglioma.[80,81,94] Mutations to the genes in isocitrate dehydrogenase 1 (*IDH1*) and in isocitrate dehydrogenase 2 (*IDH2*) have also been shown to be associated with improved prognosis in glioma. These mutations are common in lower grade gliomas (WHO grade II and WHO grade III), but are rare in glioblastoma.[84] Both of these alterations are thought to occur relatively early in the development of gliomas; the prevalence of this mutation varies by anatomic location in the brain.[95,96] The combination of these two factors can be used to more accurately stratify glioma by prognosis than the previously utilized histological criteria,[82,83] and have been incorporated into the definition of oligodendroglioma and astrocytoma in the 2016 update to the WHO classification.[18] **These classification changes are not reflected in the data presented in this report, which were collected prior to the adoption of these biomarkers as diagnostic criteria**. ***These new biomarkers began to be collected by CCR in the United States starting January 1, 2018.***

Another alteration that is associated with improved survival in glioma is increased methylation (where methyl molecules are bonded to the DNA) of the promotor region of the gene O-6-methylguanine-DNA methyltransferase (*MGMT*).[85,87] The promoter region of a gene is located upstream of the coding part of the gene and exerts control over whether a gene is transcribed into RNA. Methylation of this region effectively silences the gene, and prevents transcription into RNA. *MGMT* is a DNA repair protein, and it is assumed that the decreases in protein levels increase sensitivity to the alkylating chemotherapies (eg, temozolomide) often used in the treatment of gliomas aimed to combat tumor growth through DNA damage.[86] This alteration is common in glioblastoma and less common in lower grade gliomas. Recent analyses of data generated by The Cancer Genome Atlas have shown that genome-wide DNA methylation predicts improved prognosis in addition to methylation of specific genes.[83] Persons whose tumor has a higher proportion of methylation across the genome are termed to have glioma-CpG island methylator phenotype (G-CIMP).[88] G-CIMP and *MGMT* methylation are correlated,[97] but G-CIMP is much rarer in glioblastoma than *MGMT* methylation.

Medulloblastoma is another tumor type that has been subject to significant molecular analysis. Using an analysis of gene expression (based on quantity of RNA transcribed from a gene), medulloblastoma was able to be subdivided into four distinct subtypes: wingless (WNT), sonic hedgehog (SHH), group 3 (also called group C), and group 4 (also called group D).[89] These groups are associated with specific age-groups, with SHH being most common in infants and adults, and all other groups being more common in childhood. Several review articles have elaborated on the details of these subgroups and their implications for diagnosis and treatment.[90–92]

Diffuse intrinsic pontine glioma (DIPG) is an aggressive tumor of the brain stem that occurs primarily in children, and accounts for ~75% of brain stem tumors in children. Survival is very poor after diagnoses with these tumors. Due to the location of these tumors, they are often not biopsied and, therefore, have not been molecularly characterized to the extent of many other primary brain and other CNS tumor types. Recently, biopsy and autopsy protocols have allowed for collection of primary tumor samples that have been used for genomic profiling.[98–100] These tumors have been found to be highly heterogeneous. Mutations in histone H3, Activin A receptor, type I (*ACVR1*), tumor protein p53 (*TP53*), platelet-derived growth factor receptor A (*PDGFRA*), phosphatidylinositol 3-kinase catalytic subunit alpha (*PIK3CA*), and Myc (*MYC*) have been identified as characteristic of these tumors.[99,101,102] A recent review has further summarized recent developments in the genomics of DIPG.[103]

As of 2011, SEER registries currently collect information on three validated biomarkers for primary brain and other CNS tumors as Site Specific Factors (SSF): promoter methylation status of *MGMT* (SSF 4), deletion of the 1p (SSF 5), and deletion of 19q (SSF 6).[104] Completeness of these biomarker data varies significantly by histology, but is gradually improving over time.

Starting with diagnosis year 2018, the US cancer registry system began collecting information on multiple brain and other CNS markers, including *IDH1/2* mutation, 1p/19q codeletion, medulloblastoma molecular subtypes, and all biomarkers found in 2016 WHO classification.

Strengths and Limitations of Cancer Registry Data

CBTRUS, in collaboration with the CDC and NCI, is the largest population-based registry focused exclusively on primary brain and other CNS tumors in the US and represents cases collected from the entire US population. The *CBTRUS Statistical Report: Primary Brain and Other Central Nervous System Tumors Diagnosed in the United States in 2012–2016* contains the most up-to-date population-based data on all primary brain tumor and other CNS tumors available through the cancer surveillance system in the US.

Registration of individual cases is conducted by cancer registrars at the institution where diagnosis or treatment occurs and is then transmitted to the central cancer registry, which further transmits this information to NPCR and/or SEER. Central cancer registries (both NPCR and SEER) only report cases to the CDC and NCI for persons whot are residents of that particular state, so duplicate records should not occur for persons who may have traveled across state lines for treatment. As a result, the CBTRUS dataset is a complete recording of all cases for the time period examined with minimal duplicates.

Currently, there is no publicly available data source for the collection of survival and outcomes data from all geographic regions in the US via the cancer registry system. Survival data are collected by NPCR for 43 of the 51 CCR in the US (93% of the US population)—primarily through linkage with death certificate and other administrative records—and the feasibility of these data for use in survival studies has been evaluated[105,106] and shown to produce reliable and robust estimates of cancer survival. Use of passive follow-up with record linkage may result in overestimation of survival in some populations, such as those that are more likely to leave the state or country.

No mechanism currently exists for central pathology review of cases within the US cancer registry system, and histology code assignment at case registration is based on histology information contained in the patient's medical

record. The *WHO Classification of Tumours of the Central Nervous System* underwent revision in 1993,[107] 2000,[17] 2007,[2] and 2016.[18] As of 2018, the US cancer registry system is using the 2016 classification for data abstraction, but tumors included in this report may have been diagnosed using any of the available classifications prior to 2013 due to the variation in adoption of new standards by individual physicians and medical practices. As a result, histologies are reflective of the prevailing criteria for a histology at the time of registration. This means that despite changes to the histology schema that may occur over time, it is not possible, without additional variables, to go back and reclassify any tumors based on the new criteria. In addition to changes in histologic criteria over time, there is significant inter-rater variability in histopathological diagnosis of glioma.[108,109] This also means that incomplete, incorrect, or alternatively stated diagnoses included in a pathology report or other medical record can result in an incorrect reporting of the details of an individual case. For example, an anaplastic oligodendroglioma recorded in a pathology record as oligodendroglioma WHO grade III may be incorrectly recorded as an oligodendroglioma when the accurate category is an anaplastic oligodendroglioma.

US cancer registration requires the reporting of cases that are confirmed by different types of diagnostic procedures, including both histologic confirmation (where surgery was performed and the diagnosis confirmed by a pathologist) and radiographic confirmation (where diagnosis was made based solely on imaging criteria, such as an MRI, CT scan, or X-ray). Only histologic confirmation allows certainty on the assignment of a specific histology as well as for an assignment of a WHO grade. Many tumors have unique characteristics that make them identifiable on imaging, and thereby qualify as a valid type of diagnostic procedure, but it is important to consider the decreased level of certainty of specifying the correct histology in these tumors.

The 2016 *WHO Classification of Tumours of the Central Nervous System*[18] contains significant updating to diagnostic criteria for glioma. Oligoastrocytoma has long been considered an entity that is distinct from astrocytoma and oligodendroglioma, and is included as a unique histologic grouping within the CBTRUS Histology Grouping scheme. Recent molecular analyses suggest that these tumors are not molecularly distinct from oligodendrogliomas or astrocytomas[110] and can be separated into astrocytoma or oligodendroglioma using molecular markers; the diagnosis of oligoastrocytoma is strongly discouraged and is qualified with a "not otherwise specified" (NOS) designation under the 2016 *WHO Classification of Tumours of the Central Nervous System*. With this recent updating to the WHO criteria for central nervous system tumors,[18] *IDH1/2* mutation and 1p/19q codeletion will become the primary factors by which gliomas are classified. While data on *IDH1/2* mutation status were not collected in the US cancer registry system during the time period covered by this report, these data are required to be collected by cancer registrars (as available in the medical record) as of January 1, 2018. Cancer registry systems have collected 1p/19q deletion data for some of the report years, but data vary significantly in completeness by histology.[104] It is likely that these changes to diagnostic criteria may affect the incidence of these tumor types in future years.

Concluding Comment

The *CBTRUS Statistical Report: Primary Brain and Other Central Nervous System Tumors Diagnosed in the United States in 2012–2016* comprehensively describes the most up-to-date- (October 2019) population-based incidence, mortality, and relative survival of primary malignant and non-malignant brain and other CNS tumors collected and reported by central cancer registries covering the entire US population. This report aims to serve as a useful resource for researchers, clinicians, patients, and families. In keeping with its mission, CBTRUS continually revises its reports to reflect the current collection and reporting practices of the broader surveillance community in which it works, while integrating the input it receives from the clinical and research communities, especially from neuropathologists, when possible. In this way, CBTRUS facilitates communication between the cancer surveillance and the brain tumor research and clinical communities and contributes meaningful insight into the descriptive epidemiology of all primary brain and other CNS tumors in the United States.[111]

CBTRUS Mission

CBTRUS is a not-for-profit corporation committed to providing a resource for gathering and disseminating current epidemiologic data on all primary brain and other central nervous system tumors, benign and malignant, for the purposes of accurately describing their incidence and survival patterns, evaluating diagnosis and treatment, facilitating etiologic studies, establishing awareness of the disease, and ultimately, for the prevention of all brain tumors.

Abbreviations

AAAIR – Average Annual Age-Adjusted Incidence Rate
AAAMR – Average Annual Age-Adjusted Mortality Rate
AIAN – American Indian/Alaskan Native
AJCC – American Joint Commission on Cancer
APC – Annual Percent Change
API – Asian or Pacific Islander
AYA – Adolescents and Young Adults
ATRT – Atypical Teratoid Rhabdoid Tumor
CBTRUS – Central Brain Tumor Registry of the United States
CCR – Central Cancer Registry
CDC – Centers for Disease Control and Prevention
CS – Collaborative Staging
CI – Confidence Interval
CNS – Central Nervous System
DIPG – Diffuse Intrinsic Pontine Glioma
ICD-O-3 – International Classification of Diseases for Oncology–Third Edition
ICCC – International Classification of Childhood Cancer
IDH1/2 – Isocitrate Dehydrogenase 1/2
MGMT – O-6-Methylguanine-DNA Methyltransferase
NAACCR – North American Association of Central Cancer Registries

NCHS – National Center for Health Statistics
NCI – National Cancer Institute
NOS – Not Otherwise Specified
NPCR – National Program of Cancer Registries
NPCR-CSS – NPCR Cancer Surveillance System
NVSS – National Vital Statistics System
PNET – Primitive Neuroectodermal Tumor
SEER – Surveillance–Epidemiology–and End Results
SHH – Sonic Hedgehog
SSF – Site Specific Factors
RUCC – Rural Urban Continuum Codes
UDS – Uniform Data Standards
US – United States
USCS – United States Cancer Statistics
VACCR – Veterans Affairs Central Cancer Registry VHA–Veteran's Health Administration
WHO – World Health Organization
WNT – Wingless
YPLL – Years of Potential Life Lost

Supplementary Material

Supplementary material is available online at *Neuro-Oncology* (http://neuro-oncology.oxfordjournals.org/).

Supplementary Table 1. Main and Extended Classification for ICCC Recode ICD-O-3/WHO 2008, Based On *WHO Classification of Tumours of Haematopoietic and Lymphoid Tissues (2008)*, for Selected Histologies[1,2]

Supplementary Table 2. 2000 U.S. Standard Population

Supplementary Table 3. Average Annual Population[a] for 51 Central Cancer Registries (Including 50 States and District of Columbia) for 2012–2016 by Age, Sex, and Race

Supplementary Table 4. Average Annual Population[a] for 51 Central Cancer Registries (Including 50 States and District of Columbia) for 2012–2016 by Age, Sex, and Hispanic Ethnicity

Supplementary Table 5. Average Annual Population[a] for 51 Central Cancer Registries (Including 50 States and District of Columbia) for 2012–2016 by Age, Sex, and Urban/Rural Location of Residence[b]

Supplementary Table 6. Five-Year Total, Average Annual Total[a], and Average Annual Age-Adjusted Incidence Rates[b] with 95% Confidence Intervals for Overall Cancer Incidence, and The Most Incident Comparison Cancers (Malignant Behavior Only) by NCI Age Group, U.S. Cancer Statistics – NPCR, 2012–2016

Supplementary Table 7. Five-Year Total, Average Annual Total[a], and Average Annual Age-Adjusted Mortality Rates[b], with 95% Confidence Intervals by Cause of Death and NCI Age Group, United States, NVSS, 2012–2016

Supplementary Table 8. Five-Year Total, Average Annual Total[a], and Average Annual Age-Adjusted Incidence Rates[b] with 95% Confidence Intervals for All Brain and Other Central Nervous System Tumors by Major Histology Grouping, Histology, Behavior, and Urban/Rural Location of Residence[c], CBTRUS Statistical Report: U.S. Cancer Statistics – NPCR and SEER, 2012–2016

Supplementary Table 9. Five-Year Total, Average Annual Total[a], and Average Annual Age-Adjusted Mortality Rates[b] with 95% Confidence Intervals for Malignant Brain and Other Central Nervous System Tumors Overall and by State and Urban/Rural Location of Residence[c], United States, NVSS, 2012–2016

Supplementary Table 10. Five-Year Total, Annual Average Total[a], and Age-Adjusted and Age-Specific Incidence Rates[b] with 95% Confidence Intervals for Children and Adolescents (Age 0–19 Years), Brain and Other Central Nervous System Tumors: Malignant and Non-Malignant by International Classification of Childhood Cancer (ICCC)[c], CBTRUS Statistical Report: U.S. Cancer Statistics – NPCR and SEER, 2012–2016

Supplementary Table 11. One-, Five-, and Ten-Year Relative Survival Rates[a,B] with 95% Confidence Intervals for Selected Malignant Brain and Other Central Nervous System Tumors Overall and by Urban/Rural Location Residence[c], U.S. Cancer Statistics – NPCR Registries, 2001–2015

Supplementary Table 12. One-, Five-, and Ten-Year Relative Survival Rates[a,B] with 95% Confidence Intervals for Selected Non-Malignant Brain and Other Central Nervous System Tumors Overall and by Urban/Rural Location Residence[c], U.S. Cancer Statistics – NPCR Registries, 2004–2015

Supplementary Table 13. Annual Percent Change (APC) and 95% Confidence Intervals for Malignant Brain and Other Central Nervous System Tumors by Major Histology Grouping, Histology, Behavior, and Sex, CBTRUS Statistical Report: U.S. Cancer Statistics – NPCR and SEER, 2000–2016

Supplementary Table 14. Annual Percent Change (APC) and 95% Confidence Intervals for Non-Malignant Brain and Other Central Nervous System Tumors by Major Histology Grouping, Histology, Behavior, and Sex, CBTRUS Statistical Report: NPCR and SEER, 2004–2016

Supplementary Figure 1. Average Annual Age-Adjusted Incidence Rates[a] with 95% Confidence Intervals of All Primary Brain and Other CNS Tumors in Comparison To The Top Eight Most Common Cancers in Males Only for A) Children Age 0–14 Years, B) Adolescents and Young Adults Age 15–39 Years, and C) Older Adults Age 40+ Years, CBTRUS Statistical Report: U.S. Cancer Statistics – NPCR and SEER 2012–2016

Supplementary Figure 2. Average Annual Age-Adjusted Incidence Rates[a] with 95% Confidence Intervals of All Primary Brain and Other CNS Tumors in Comparison To Top Eight Most Common Cancers in Females Only for A) Children Age 0–14 Years, B) Adolescents and Young Adults Age 15–39 Years, and C) Older Adults Age 40+ Years, CBTRUS Statistical Report: U.S. Cancer Statistics – NPCR and SEER 2012–2016, USCS, 2012–2016

Supplementary Figure 3. Average Annual Age-Adjusted Mortality Rates[a] with 95% Confidence Intervals of All Primary Brain and Other CNS Tumors in Comparison To Top Five Common Causes of Cancer Death and Top Three Non-Cancer Causes of Death in Males Only for A) Children Age 0–14 Years, B) Adolescents and Young Adults Age 15–39 Years, and C) Older Adults Age 40+ Years, CBTRUS Statistical Report: NVSS, 2012–2016

Supplementary Figure 4. Average Annual Age-Adjusted Mortality Rates[a] with 95% Confidence Intervals of All Primary Brain and Other CNS Tumors in Comparison To The Top Five Causes of Cancer Deaths and Top Three Non-Cancer Causes of Death in Females Only for A) Children

Age 0–14 Years, B) Adolescents and Young Adults Age 15–39 Years, and C) Older Adults Age 40+ Years, CBTRUS Statistical Report: NVSS, 2012–2016

Supplementary Figure 5. Distribution[a] of Malignant Primary Brain and Other CNS Tumors by Major Histology Groups (Five-Year Total = 122,569; Annual Average Cases = 24,514), CBTRUS Statistical Report: U.S. Cancer Statistics – NPCR and SEER, 2012–2016

Supplementary Figure 6. Distribution[a] of Non-Malignant Primary Brain and Other CNS Tumors by Major Histology Groups (Five-Year Total = 283,171; Annual Average Cases = 56,634), CBTRUS Statistical Report: U.S. Cancer Statistics – NPCR and SEER, 2012–2016

Supplementary Figure 7. Annual Age-Adjusted Incidence Rates[a] of Primary Brain and Other CNS Tumors by Year and Behavior, by Sex, CBTRUS Statistical Report: U.S. Cancer Statistics – NPCR and SEER, 2012–2016

Supplementary Figure 8. Distribution[a] of Primary Brain and Other CNS Tumors by Site, Males Only, A) Overall (Five-Year Total = 169,868; Annual Average Cases = 33,974), B) Malignant (Five-Year Total = 67,930; Annual Average Cases = 13,586), and C) Non-Malignant (Five-Year Total = 101,938; Annual Average Cases = 20,388), CBTRUS Statistical Report: U.S. Cancer Statistics – NPCR and SEER, 2012–2016

Supplementary Figure 9. Distribution[a] of All Primary Brain and Other CNS Tumors by Site, Females Only, A) Overall (Five-Year Total = 235,872; Annual Average Cases = 47,174), B) Malignant (Five-Year Total = 54,639; Annual Average Cases = 10,928), and C) Non-Malignant (Five-Year Total = 181,233; Annual Average Cases = 36,247), CBTRUS Statistical Report: U.S. Cancer Statistics – NPCR and SEER, 2012–2016

Supplementary Figure 10. Distribution[a] of All Primary Brain and Other CNS Tumors by CBTRUS Histology Groupings and Histology, Males Only, A) Overall (Five-Year Total = 169,868; Annual Average Cases = 33,974), B) Malignant (Five-Year Total = 67,930; Annual Average Cases = 13,586), and C) Non-Malignant (Five-Year Total = 101,938; Annual Average Cases = 20,388), CBTRUS Statistical Report: U.S. Cancer Statistics – NPCR and SEER, 2012–2016

Supplementary Figure 11. Distribution[a] of All Primary Brain and Other CNS Tumors by CBTRUS Histology Groupings and Histology, Females Only, A) Overall (Five-Year Total = 235,872; Annual Average Cases = 47,174), B) Malignant (Five-Year Total = 54,639; Annual Average Cases = 10,928), and C) Non-Malignant (Five-Year Total = 181,233; Annual Average Cases = 36,247), CBTRUS Statistical Report: U.S. Cancer Statistics – NPCR and SEER, 2012–2016

Supplementary Figure 12. Average Annual Age-Adjusted Incidence Rates[a] of All Primary Brain and Other CNS Tumors by Age and Behavior, by Sex, CBTRUS Statistical Report: U.S. Cancer Statistics – NPCR and SEER, 2012–2016

Supplementary Figure 13. Average Annual Age-Adjusted Incidence Rates[a] of Malignant and Non-Malignant Primary Brain and Other CNS Tumors by Central Cancer Registry, CBTRUS Statistical Report: U.S. Cancer Statistics – NPCR and SEER, 2012–2016

Supplementary Figure 14. Distribution[a] of All Primary Brain and Other CNS Tumors Diagnosed in Puerto Rico by Behavior (Five-Year Total = 2,393; Annual Average Cases = 479), CBTRUS Statistical Report: U.S. Cancer Statistics – NPCR, 2012–2016

Supplementary Figure 15. Incidence Rate Ratios for Meningioma with 95% Confidence Intervals by Behavior, Sex (Females:Males), and Age Group, CBTRUS Statistical Report: U.S. Cancer Statistics – NPCR and SEER, 2012–2016

Supplementary Figure 16. Relative Survival Rates for Meningioma by Behavior and Site, CBTRUS Statistical Report: U.S. Cancer Statistics – NPCR, 2004–2015

Supplementary Figure 17. Incidence Rate Ratios in Children (Age 0–14 Years) for Selected Embryonal Histologies by Sex (Males:Females), CBTRUS Statistical Report: U.S. Cancer Statistics – NPCR and SEER, 2012–2016

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Disclaimer

CBTRUS is a not-for-profit corporation which gathers and disseminates epidemiologic data on primary brain and other central nervous system tumors in order to facilitate research and establish awareness of the disease. CBTRUS makes no representations or warranties, and gives no other assurances or guarantees, express or implied, with respect to the accuracy or completeness of the data presented. The information provided in this report is not intended to assist in the evaluation, diagnosis, or treatment of individual diseases. Persons with questions regarding individual diseases should contact their own physician to obtain medical assistance. The contents in this report are solely the responsibility of the authors and do not necessarily represent the official views of the Centers for Disease Control and Prevention or of the National Cancer Institute.

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References

1. Kruchko C, Ostrom QT, Gittleman H, Barnholtz-Sloan JS. The CBTRUS story: providing accurate population-based statistics on brain and other central nervous system tumors for everyone. *Neuro Oncol.* 2018;20(3):295–298.
2. Louis D, Wiestler O, Cavanee W, eds. *WHO Classification of Tumours of the Central Nervous System.* Lyon, France: International Agency for Research on Cancer; 2007.
3. Ostrom QT, Gittleman H, Liao P, et al. CBTRUS statistical report: primary brain and central nervous system tumors diagnosed in the United States in 2007–2011. *Neuro. Oncol.* 2014;16(s4):iv1–iv63.
4. Centers for Disease Control and Prevention (CDC). National Program of Cancer Registries Cancer Surveillance System Rationale and Approach. 1999; http://www.cdc.gov/cancer/npcr/pdf/npcr_css.pdf. Accessed September 24, 2019.
5. Wiśniewski JR, Zougman A, Nagaraj N, Mann M. Universal sample preparation method for proteome analysis. *Nat Methods.* 2009;6(5):359–362.
6. *Benign Brain Tumor Cancer Registries Amendment Act, 107th Cong.* § 260 2002. https://www.govinfo.gov/app/details/CREC-2002-08-01/CREC-2002-08-01-pt2-PgS8022-3. Accessed September 24, 2019
7. National Cancer Institute. Overview of the SEER Program. http://seer.cancer.gov/about/overview.html. Accessed September 24, 2019.
8. Wöhrer A, Waldhör T, Heinzl H, et al. The Austrian Brain Tumour Registry: a cooperative way to establish a population-based brain tumour registry. *J Neurooncol.* 2009;95(3):401–411.
9. Asklund T, Malmstrom A, Bergqvist M, Bjor O, Henriksson R. Brain tumors in Sweden: data from a population-based registry 1999–2012. *Acta Oncol.* 2015;54(3):377–384.
10. Centers for Disease Control and Prevention National Center for Health Statistics. *National Program of Cancer Registries and Surveillance, Epidemiology, and End Results SEER*Stat Database: U.S. Cancer Statistics Incidence Analytic Database – 1998–2016.* Bethesda, MD: United States Department of Health and Human Services, Centers for Disease Control and Prevention and National Cancer Institute; 2019. Based on the November 2018 submission.
11. Fritz A, Percy C, Jack A, Shanmugaratnam K, Sobin L, Parkin DM, Whelan S, eds. *International Classification of Diseases for Oncology.* 3rd ed. World Health Organization; 2000.
12. Surveillance Epidemiology and End Results (SEER) Program. SEER*Stat Database: Mortality - All COD, Aggregated With State, Total U.S. (1969–2016) <Katrina/Rita Population Adjustment>, Bethesda, MD: National Cancer Institute, DCCPS, Surveillance Research Program, released December 2018. Underlying mortality data provided by NCHS. www.cdc.gov/nchs.
13. McCarthy BJ, Surawicz T, Bruner JM, Kruchko C, Davis F. Consensus Conference on Brain Tumor Definition for registration. November 10, 2000. *Neuro Oncol.* 2002;4(2):134–145.
14. Surveillance Research Program - National Cancer Institute. ICCC Recode ICD-O-3/WHO. 2008. http://seer.cancer.gov/iccc/iccc-who2008.html. Accessed September 24, 2019.
15. Steliarova-Foucher E, Stiller C, Lacour B, Kaatsch P. International classification of childhood cancer, third edition. *Cancer.* 2005;103(7):1457–1467.
16. Swerdlow SH, Campo E, Harris NL, et al. *WHO Classification of Tumours of Haematopoietic and Lymphoid Tissues.* 4th ed. World Health Organization; 2007.
17. Kleihues P, Cavenee W, eds. *Tumours of the Nervous System: World Health Organization Classification of Tumours.* Lyon, France: IARC Press; 2000.

18. Louis DN, Ohgaki H, Wiestler OD, Cavenee WK, eds. *WHO Classification of Tumours of the Central Nervous System*. Lyon, France: International Agency for Research on Cancer; 2016.
19. American Joint Committee on Cancer. Collaborative Stage Data Collection System. 2015. http://www.cancerstaging.org/cstage/. Accessed September 24, 2019.
20. Lym RL, Ostrom QT, Kruchko C, et al. Completeness and concordancy of WHO grade assignment for brain and central nervous system tumors in the United States, 2004–2011. *J. Neurooncol.* 2015;123(1):43–51.
21. Surveillance Research Program - National Cancer Institute. ICD-0–3 SEER Site/Histology Validation List. 2019. https://www.google.com/url?sa=t&rct=j&q=&esrc=s&source=web&cd=2&cad=rja&uact=8&ved=2ahUKEwiYh_zy6-nkAhXKI54KHb8RBmcQFjABegQIABAC&url=https%3A%2F%2Fseer.cancer.gov%2Ficd-o-3%2Fsitetype.icdo3.20190618.pdf&usg=AOvVaw2ajRWYKzw4HwVL1yj0j6KV. Accessed September 24, 2019.
22. R Core Team. R: A language and environment for statistical computing. 2019. http://www.R-project.org/. Accessed September 24, 2019.
23. Surveillance Epidemiology and End Results (SEER) Program. SEER*Stat software version 8.3.5. 2019. www.seer.cancer.gov/seerstat. Accessed September 24, 2019.
24. Wickham H. ggplot2: elegant graphics for data analysis. 2019. https://ggplot2.tidyverse.org/. Accessed September 24, 2019
25. Bivand R, Rundel C. rgeos: Interface to Geometry Engine - Open Source (GEOS). R package version 0.5–11. 2019. http://CRAN.R-project.org/package=rgeos. Accessed September 24, 2019.
26. Bivand R, Keitt T, Rowlingson B. rgdal: Bindings for the Geospatial Data Abstraction Library. R package version 1.4–4. 2019. http://CRAN.R-project.org/package=rgdal. Accessed September 24, 2019.
27. Luo J. SEER2R: reading and writing SEER*STAT data files. R package version 1.0. 2012. http://CRAN.R-project.org/package=SEER2R. Accessed September 24, 2019.
28. Bivand R, Lewin-Koh N. maptools: Tools for Reading and Handling Spatial Objects. R package version 0.8–36. 2015. http://CRAN.R-project.org/package=maptools. Accessed September 24, 2019.
29. Gohel D. officer: Manipulation of Microsoft Word and PowerPoint Documents. 2019. https://davidgohel.github.io/officer. Accessed September 24, 2019.
30. Gohel D. flextable: Functions for Tabular Reporting. 2019. https://CRAN.R-project.org/package=flextable. Accessed September 24, 2019.
31. Bache SM, Wickham H. magrittr: A Forward-Pipe Operator for R. 2014. https://CRAN.R-project.org/package=magrittr. Accessed September 24, 2019.
32. Surveillance Epidemiology and End Results (SEER) Program. SEER*Stat Database: Populations - Total U.S. (1990–2017) - Linked To County Attributes - Total U.S., 1969–2017 Counties, National Cancer Institute, DCCPS, Surveillance Research Program, released December 2018. http://seer.cancer.gov/popdata/.
33. Tiwari RC, Clegg LX, Zou Z. Efficient interval estimation for age-adjusted cancer rates. *Stat Methods Med Res.* 2006;15(6):547–569.
34. NAACCR Race and Ethnicity Work Group. *NAACCR Guideline for Enhancing Hispanic/Latino Identification: Revised NAACCR Hispanic/Latino Identification Algorithm [NHIA v2.2.1].* Springfield, IL: North American Association of Central Cancer Registries. September. 2011. https://www.naaccr.org/wp-content/uploads/2016/11/NHIA_v2_2_1_09122011.pdf. Accessed September 24, 2019.
35. United States Department of Agriculture. 2013 Rural Urban Continuum Codes. 2013. https://www.ers.usda.gov/data-products/rural-urban-continuum-codes/documentation.aspx. Accessed September 24, 2019.
36. *Joinpoint Regression Program, Version 4.7.0.0.* Bethesda, MD: Statistical Methodology and Applications Branch, Surveillance Research Program, National Cancer Institute; 2019.
37. Kim HJ, Fay MP, Feuer EJ, Midthune DN. Permutation tests for joinpoint regression with applications to cancer rates. *Stat Med.* 2000;19(3):335–351.
38. Zhu L, Pickle LW, Ghosh K, et al. Predicting US- and state-level cancer counts for the current calendar year: Part II: evaluation of spatiotemporal projection methods for incidence. *Cancer.* 2012;118(4):1100–1109.
39. Edwards BK, Noone AM, Mariotto AB, et al. Annual Report to the Nation on the status of cancer, 1975–2010, featuring prevalence of comorbidity and impact on survival among persons with lung, colorectal, breast, or prostate cancer. *Cancer.* 2014;120(9):1290–1314.
40. Zullig LL, Jackson GL, Dorn RA, et al. Cancer incidence among patients of the U.S. Veterans Affairs Health Care System. *Mil Med.* 2012;177(6):693–701.
41. Clegg LX, Feuer EJ, Midthune DN, Fay MP, Hankey BF. Impact of reporting delay and reporting error on cancer incidence rates and trends. *J. Natl. Cancer Inst.* 2002;94(20):1537–1545.
42. Midthune DN, Fay MP, Clegg LX, Feuer EJ. Modeling reporting delays and reporting corrections in cancer registry data. *J Am Stat Assoc.* 2005;100(469):61–70.
43. Surveillance Epidemiology and End Results (SEER) Program. Cancer Incidence Rates Adjusted for Reporting Delay. 2016. http://surveillance.cancer.gov/delay/. Accessed September 24, 2019.
44. Li XR, Kruchko C, Wu XC, et al. Are benign and borderline brain tumors underreported? *J Registry Manag.* 2016;43(4):187–194.
45. Anderson RN, Rosenberg HM. Report of the second workshop on age adjustment. *Vital Health Stat 4.* 1998;(30):I-vi, 1–37.
46. Anderson RN, Rosenberg HM. Age standardization of death rates: implementation of the year 2000 standard. *Natl Vital Stat Rep.* 1998;47(3):1–16, 20.
47. Dickie L, Johnson C, Adams S, Negoita S. *Solid Tumor Rules.* Rockville, MD: National Cancer Institute; 2018.
48. Johnson C, Peace S, Adamo P, Fritz A, Percy-Laurry A, Edwards B. *The 2007 Multiple Primary and Histology Coding Rules.* Bethesda, MD: National Cancer Institute; 2007.
49. Ostrom QT, de Blank PM, Kruchko C, et al. Alex's Lemonade Stand Foundation Infant and childhood primary brain and central nervous system tumors diagnosed in the United States in 2007–2011. *Neuro Oncol.* 2015;16(Suppl 10):x1–x36.
50. de Blank PM, Ostrom QT, Rouse C, et al. Years of life lived with disease and years of potential life lost in children who die of cancer in the United States, 2009. *Cancer Med.* 2015;4(4):608–619.
51. National Cancer Institute at the National Institutes of Health. Adolescents and Young Adults with Cancer. http://www.cancer.gov/cancertopics/aya. Accessed September 24, 2019.
52. Ostrom QT, Gittleman H, de Blank PM, et al. American brain tumor association adolescent and young adult primary brain and central nervous system tumors diagnosed in the United States in 2008–2012. *Neuro Oncol.* 2016;18(Suppl 1):i1–i50.
53. Siegel RL, Miller KD, Jemal A. Cancer statistics, 2019. *CA Cancer J Clin.* 2019;69(1):7–34.
54. McCarthy BJ, Kruchko C, Dolecek TA. The impact of the Benign Brain Tumor Cancer Registries Amendment Act (Public Law 107–260) on nonmalignant brain and central nervous system tumor incidence trends. *J Registry Manag.* 2013;40(1):32–35.
55. Gittleman HR, Ostrom QT, Rouse CD, et al. Trends in central nervous system tumor incidence relative to other common cancers in adults, adolescents, and children in the United States, 2000 to 2010. *Cancer.* 2015;121(1):102–112.
56. Kshettry VR, Ostrom QT, Kruchko C, Al-Mefty O, Barnett GH, Barnholtz-Sloan JS. Descriptive epidemiology of World Health Organization

grades II and III intracranial meningiomas in the United States. *Neuro Oncol.* 2015;17(8):1166–1173.

57. Zhang AS, Ostrom QT, Kruchko C, Rogers L, Peereboom DM, Barnholtz-Sloan JS. Complete prevalence of malignant primary brain tumors registry data in the United States compared with other common cancers, 2010. *Neuro Oncol.* 2016;19(5):726–735.
58. Gittleman H, Boscia A, Ostrom QT, et al. Survivorship in adults with malignant brain and other central nervous system tumor from 2000–2014. *Neuro Oncol.* 2018;20(Suppl 7):vii6–vii16.
59. Rouse C, Gittleman H, Ostrom QT, Kruchko C, Barnholtz-Sloan JS. Years of potential life lost for brain and CNS tumors relative to other cancers in adults in the United States, 2010. *Neuro Oncol.* 2016;18(1):70–77.
60. *DevCan: Probability of Developing or Dying of Cancer Software, Version 6.2.0*. Statistical Research and Applications Branch, National Cancer Institute; 2007. http://srab.cancer.gov/devcan/ [computer program].
61. Fay MP, Pfeiffer R, Cronin KA, Le C, Feuer EJ. Age-conditional probabilities of developing cancer. *Stat Med.* 2003;22(11):1837–1848.
62. Fay MP. Estimating age conditional probability of developing disease from surveillance data. *Popul Health Metr.* 2004;2(1):6.
63. Surveillance Epidemiology and End Results (SEER) Program. *DevCan database: "SEER 18 Incidence and Mortality, 2000–2016, with Kaposi Sarcoma and Mesothelioma"*. National Cancer Institute, DCCPS, Surveillance Research Program, Surveillance Systems Branch; 2019, based on the November 2018 submission. Underlying mortality data provided by NCHS.
64. Braganza MZ, Kitahara CM, Berrington de Gonzalez A, Inskip PD, Johnson KJ, Rajaraman P. Ionizing radiation and the risk of brain and central nervous system tumors: a systematic review. *Neuro Oncol.* 2012;14(11):1316–1324.
65. Amirian ES, Zhou R, Wrensch MR, et al. Approaching a scientific consensus on the association between allergies and glioma risk: a report from the glioma international case-control study. *Cancer Epidemiol Biomarkers Prev.* 2016;25(2):282–290.
66. Malmer B, Henriksson R, Grönberg H. Familial brain tumours—genetics or environment? A nationwide cohort study of cancer risk in spouses and first-degree relatives of brain tumour patients. *Int J Cancer.* 2003;106(2):260–263.
67. Wrensch M, Lee M, Miike R, et al. Familial and personal medical history of cancer and nervous system conditions among adults with glioma and controls. *Am J Epidemiol.* 1997;145(7):581–593.
70. Malmer B, Grönberg H, Bergenheim AT, Lenner P, Henriksson R. Familial aggregation of astrocytoma in northern Sweden: an epidemiological cohort study. *Int J Cancer.* 1999;81(3):366–370.
69. Hill DA, Inskip PD, Shapiro WR, et al. Cancer in first-degree relatives and risk of glioma in adults. *Cancer Epidemiol Biomarkers Prev.* 2003;12(12):1443–1448.
70. Scheurer ME, Etzel CJ, Liu M, et al. Aggregation of cancer in first-degree relatives of patients with glioma. *Cancer Epidemiol Biomarkers Prev.* 2007;16(11):2491–2495.
71. Ostrom QT, Bauchet L, Davis F, et al. The epidemiology of glioma in adults: a "state of the science" review. *Neuro Oncol.* 2014;16(7):896–913.
72. Johnson KJ, Cullen J, Barnholtz-Sloan JS, et al. Childhood brain tumor epidemiology: a brain tumor epidemiology consortium review. *Cancer Epidemiol Biomarkers Prev.* 2014;23(12):2716–2736.
73. Wiemels J, Wrensch M, Claus EB. Epidemiology and etiology of meningioma. *J Neurooncol.* 2010;99(3):307–314.
74. Ostrom QT, Adel Fahmideh M, Cote DJ, et al. Risk factors for childhood and adult primary brain tumors. *Neuro Oncol.* 2019.
75. Scheie D, Kufaishi HHA, Broholm H, et al. Biomarkers in tumors of the central nervous system - a review. *APMIS.* 2019;127(5):265–287.
76. Velazquez Vega JE, Brat DJ. Incorporating advances in molecular pathology into brain tumor diagnostics. *Adv Anat Pathol.* 2018;25(3):143–171.
77. Guerreiro Stucklin AS, Ramaswamy V, Daniels C, Taylor MD. Review of molecular classification and treatment implications of pediatric brain tumors. *Curr Opin Pediatr.* 2018;30(1):3–9.
78. Cairncross JG, Ueki K, Zlatescu MC, et al. Specific genetic predictors of chemotherapeutic response and survival in patients with anaplastic oligodendrogliomas. *J Natl Cancer Inst.* 1998;90(19):1473–1479.
79. Vogelbaum MA, Hu C, Peereboom DM, et al. Phase II trial of preirradiation and concurrent temozolomide in patients with newly diagnosed anaplastic oligodendrogliomas and mixed anaplastic oligoastrocytomas: long term results of RTOG BR0131. *J Neurooncol.* 2015;124(3):413–420.
80. van den Bent MJ, Brandes AA, Taphoorn MJ, et al. Adjuvant procarbazine, lomustine, and vincristine chemotherapy in newly diagnosed anaplastic oligodendroglioma: long-term follow-up of EORTC brain tumor group study 26951. *J Clin Oncol.* 2013;31(3):344–350.
81. The Cancer Genome Atlas Research Network, Brat DJ, Verhaak RG, et al. Comprehensive, integrative genomic analysis of diffuse lower-grade gliomas. *N Engl J Med.* 2015;372(26):2481–2498.
82. Ceccarelli M, Barthel FP, Malta TM, et al. Molecular profiling reveals biologically discrete subsets and pathways of progression in diffuse glioma. *Cell.* 2016;164(3):550–563.
83. Yan H, Parsons DW, Jin G, et al. IDH1 and IDH2 mutations in gliomas. *N Engl J Med.* 2009;360(8):765–773.
84. Hegi ME, Diserens AC, Gorlia T, et al. MGMT gene silencing and benefit from temozolomide in glioblastoma. *N Engl J Med.* 2005;352(10):997–1003.
85. Stupp R, Hegi ME, Gilbert MR, Chakravarti A. Chemoradiotherapy in malignant glioma: standard of care and future directions. *J Clin Oncol.* 2007;25(26):4127–4136.
86. Hegi ME, Liu L, Herman JG, et al. Correlation of O6-methylguanine methyltransferase (MGMT) promoter methylation with clinical outcomes in glioblastoma and clinical strategies to modulate MGMT activity. *J Clin Oncol.* 2008;26(25):4189–4199.
87. Noushmehr H, Weisenberger DJ, Diefes K, et al. Identification of a CpG island methylator phenotype that defines a distinct subgroup of glioma. *Cancer Cell.* 2010;17(5):510–522.
88. Kool M, Korshunov A, Remke M, et al. Molecular subgroups of medulloblastoma: an international meta-analysis of transcriptome, genetic aberrations, and clinical data of WNT, SHH, Group 3, and Group 4 medulloblastomas. *Acta Neuropathol.* 2012;123(4):473–484.
89. Northcott PA, Dubuc AM, Pfister S, Taylor MD. Molecular subgroups of medulloblastoma. *Expert Rev Neurother.* 2012;12(7):871–884.
90. Northcott PA, Jones DT, Kool M, et al. Medulloblastomics: the end of the beginning. *Nat Rev Cancer.* 2012;12(12):818–834.
91. Northcott PA, Buchhalter I, Morrissy AS, et al. The whole-genome landscape of medulloblastoma subtypes. *Nature.* 2017;547(7663):311–317.
92. Reifenberger G, Wirsching HG, Knobbe-Thomsen CB, Weller M. Advances in the molecular genetics of gliomas - implications for classification and therapy. *Nat Rev Clin Oncol.* 2017;14(7):434–452.
93. Cairncross G, Wang M, Shaw E, et al. Phase III trial of chemoradiotherapy for anaplastic oligodendroglioma: long-term results of RTOG 9402. *J Clin Oncol.* 2013;31(3):337–343.
94. Qi S, Yu L, Li H, et al. Isocitrate dehydrogenase mutation is associated with tumor location and magnetic resonance imaging characteristics in astrocytic neoplasms. *Oncol Lett.* 2014;7(6):1895–1902.
95. Paldor I, Pearce FC, Drummond KJ, Kaye AH. Frontal glioblastoma multiforme may be biologically distinct from non-frontal and multilobar tumors. *J Clin Neurosci.* 2016;34:128–132.

96. van den Bent MJ, Erdem-Eraslan L, Idbaih A, et al. MGMT-STP27 methylation status as predictive marker for response to PCV in anaplastic Oligodendrogliomas and Oligoastrocytomas. A report from EORTC study 26951. *Clin. Cancer Res.* 2013;19(19):5513–5522.
97. Jones C, Baker SJ. Unique genetic and epigenetic mechanisms driving paediatric diffuse high-grade glioma. *Nat Rev.Cancer.* 2014;14(10).
98. Wu G, Diaz AK, Paugh BS, et al. The genomic landscape of diffuse intrinsic pontine glioma and pediatric non-brainstem high-grade glioma. *Nat Genet.* 2014;46(5):444–450.
99. Mackay A, Burford A, Carvalho D, et al. Integrated molecular meta-analysis of 1,000 pediatric high-grade and diffuse intrinsic pontine glioma. *Cancer Cell.* 2017;32(4):520–537 e525.
100. Hoffman LM, DeWire M, Ryall S, et al. Spatial genomic heterogeneity in diffuse intrinsic pontine and midline high-grade glioma: implications for diagnostic biopsy and targeted therapeutics. *Acta Neuropathol Commun.* 2016;4:1.
101. Grill J, Puget S, Andreiuolo F, Philippe C, MacConaill L, Kieran MW. Critical oncogenic mutations in newly diagnosed pediatric diffuse intrinsic pontine glioma. *Pediatr Blood Cancer.* 2012;58(4):489–491.
102. Lapin DH, Tsoli M, Ziegler DS. Genomic insights into diffuse intrinsic pontine glioma. *Front Oncol.* 2017;7:57.
103. Ostrom QT, Gittleman H, Kruchko C, et al. Completeness of required site-specific factors for brain and CNS tumors in the Surveillance, Epidemiology and End Results (SEER) 18 database (2004–2012, varying). *J Neurooncol.* 2016; 130(1):31–42.
104. Weir HK, Johnson CJ, Mariotto AB, et al. Evaluation of North American Association of Central Cancer Registries' (NAACCR) data for use in population-based cancer survival studies. *J Natl Cancer Inst Monogr.* 2014;2014(49):198–209.
105. Wilson RJ, O'Neil ME, Ntekop E, Zhang K, Ren Y. Coding completeness and quality of relative survival-related variables in the National Program of Cancer Registries Cancer Surveillance System, 1995–2008. *J Registry Manag.* 2014;41(2):65–71; quiz 96-67.
106. Kleihues P, Burger PC, Scheithauer BW. The new WHO classification of brain tumours. *Brain Pathol.* 1993;3(3):255–268.
107. van den Bent MJ. Interobserver variation of the histopathological diagnosis in clinical trials on glioma: a clinician's perspective. *Acta Neuropathol.* 2010;120(3):297–304.
108. Aldape K, Simmons ML, Davis RL, et al. Discrepancies in diagnoses of neuroepithelial neoplasms: the San Francisco Bay Area Adult Glioma Study. *Cancer.* 2000;88(10):2342–2349.
109. Sahm F, Reuss D, Koelsche C, et al. Farewell to oligoastrocytoma: in situ molecular genetics favor classification as either oligodendroglioma or astrocytoma. *Acta Neuropathol.* 2014;128(4):551–559.
110. Jiao Y, Killela PJ, Reitman ZJ, et al. Frequent ATRX, CIC, FUBP1 and IDH1 mutations refine the classification of malignant gliomas. *Oncotarget.* 2012;3(7):709–722.
111. Kruchko C, Gittleman H, Ruhl J, Hofferkamp J, Ward EM, Ostrom QT, Sherman RL, Jones SF, Barnholtz-Sloan JS, Wilson RJ. Cancer collection efforts in the United States provide clinically relevant data on all primary brain and other CNS tumors. Neurooncol Pract. 2019 Sep;6(5):330–339. doi: 10.1093/nop/npz029. Epub 2019 Jul 2. Review. PubMed PMID: 31555447; PubMed Central PMCID: PMC6753356.
112. Wiestler B, Capper D, Holland-Letz T, et al. ATRX loss refines the classification of anaplastic gliomas and identifies a subgroup of IDH mutant astrocytic tumors with better prognosis. *Acta Neuropathol.* 2013;126(3):443–451.
113. Maire CL, Ligon KL. Molecular pathologic diagnosis of epidermal growth factor receptor. *Neuro Oncol.* 2014;16(Suppl 8):viii1–viii6.
114. Arita H, Narita Y, Fukushima S, et al. Upregulating mutations in the TERT promoter commonly occur in adult malignant gliomas and are strongly associated with total 1p19q loss. *Acta Neuropathol.* 2013;126(2):267–276.
115. Eckel-Passow JE, Lachance DH, Molinaro AM, et al. Glioma groups based on 1p/19q, IDH, and TERT promoter mutations in tumors. *N Engl J Med.* 2015;372(26):2499–2508.
116. Hawkins C, Walker E, Mohamed N, et al. BRAF-KIAA1549 fusion predicts better clinical outcome in pediatric low-grade astrocytoma. *Clin Cancer Res.* 2011;17(14):4790–4798.
117. Ceccom J, Bourdeaut F, Loukh N, et al. Embryonal tumor with multilayered rosettes: diagnostic tools update and review of the literature. *Clin Neuropathol.* 2014;33(1):15–22.
118. Korshunov A, Sturm D, Ryzhova M, et al. Embryonal tumor with abundant neuropil and true rosettes (ETANTR), ependymoblastoma, and medulloepithelioma share molecular similarity and comprise a single clinicopathological entity. *Acta Neuropathol.* 2014;128(2):279–289.

Table 1 Central Brain Tumor Registry of the United States (CBTRUS), brain and other central nervous system tumor site groupings

Site	ICD-O-3[a] Site Code
Cerebrum	C71.0
Frontal lobe of brain	C71.1
Temporal lobe of brain	C71.2
Parietal lobe of brain	C71.3
Occipital lobe of brain	C71.4
Ventricle	C71.5
Cerebellum	C71.6
Brain stem	C71.7
Other brain	C71.8-C71.9
Overlapping lesion of brain	*C71.8*
Brain, NOS	*C71.9*
Spinal cord and cauda equina	C72.0-C72.1
Spinal cord	*C72.0*
Cauda equine	*C72.1*
Cranial nerves	C72.2-C72.5
Olfactory nerve	*C72.2*
Optic nerve	*C72.3*
Acoustic nerve	*C72.4*
Cranial nerve, NOS	*C72.5*
Other nervous system	C72.8-C72.9
Overlapping lesion of brain and central nervous system	*C72.8*
Nervous system, NOS	*C72.9*
Meninges (cerebral & spinal)	C70.0-C70.9
Cerebral meninges	*C70.0*
Spinal meninges	*C70.1*
Meninges, NOS	*C70.9*
Pituitary and craniopharyngeal duct	C75.1-C75.2
Pituitary gland	*C75.1*
Craniopharyngeal duct	*C75.2*
Pineal gland	C75.3
Olfactory tumors of the nasal cavity[b]	C30.0

a.International Classification of Diseases for Oncology, 3rd Edition, 2000. World Health Organization, Geneva, Switzerland.
b.ICD-O-3 histology codes 9522–9523 only.
Abbreviations: CBTRUS, Central Brain Tumor Registry of the United States; NOS, Not otherwise specified

Table 2 Central Brain Tumor Registry of the United States (CBTRUS), Brain and Other Central Nervous System Tumor Histology Groupings

Histology	ICD-O-3[a] Histology Codes[b]	ICD-O-3[a] Histology and Behavior Code[b]	
		Malignant (ICD-O-3 Behavior code /3)	Non-Malignant (ICD-O-3 Behavior Codes /0 and /1)
Tumors of Neuroepithelial Tissue			
Pilocytic astrocytoma*	9421, 9425[c]	9421/1[d], 9425/3[c]	*None*
Diffuse astrocytoma*	9400, 9410, 9411, 9420	9400/3, 9410/3, 9411/3, 9420/3	*None*
Anaplastic astrocytoma*	9401	9401/3	*None*
Unique astrocytoma variants*	9381, 9384, 9424	9381/3, 9424/3	9384/1
Glioblastoma*	9440, 9441, 9442/3[e]	9440/3, 9441/3, 9442/3	*None*
Oligodendroglioma*	9450	9450/3	*None*
Anaplastic oligodendroglioma*	9451, 9460	9451/3, 9460/3	*None*
Oligoastrocytic tumors*	9382	9382/3	*None*
Ependymal tumors*	9383, 9391, 9392, 9393, 9394	9391/3, 9392/3, 9393/3	9383/1, 9394/1
Glioma malignant, NOS*	9380, 9431[c], 9432[c]	9380/3, 9431/1[c], 9432/1[c]	*None*
Choroid plexus tumors	9390	9390/3	9390/0,1
Other neuroepithelial tumors*	9363, 9423, 9430, 9444	9423/3, 9430/3	9363/0, 9444/1
Neuronal and mixed neuronal-glial tumors*	8680, 8681, 8690, 8693, 9412, 9413, 9442/1[f], 9492 (excluding site C75.1), 9493, 9505, 9506, 9522, 9523	8680/3, 8693/3, 9505/3, 9522/3, 9523/3	8680/0,1, 8681/1, 8690/1, 8693/1, 9412/1, 9413/0, 9442/1, 9492/0 (excluding site C75.1), 9493/0, 9505/1, 9506/1, 9509/1,
Tumors of the pineal region	9360, 9361, 9362, 9395[c]	9362/3, 9395/3[c]	9360/1, 9361/1
Embryonal tumors	8963, 9364, 9470–9474, 9480, 9490, 9500–9502, 9508	8963/3, 9364/3, 9470/3, 9471/3, 9472/3, 9473/3, 9474/3, 9480/3, 9490/3, 9500/3, 9501/3, 9502/3, 9508/3	9490/0
Medulloblastoma	*9470–9472, 9474*	*9470/3, 9471/3, 9472/3, 9474/3.*	*None*
Primitive neuroectodermal tumor	*9508*	*9508/3.*	*None*
Atypical teratoid/rhabdoid tumor	*9473*	*9473/3*	*None*
Tumors of Cranial and Spinal Nerves			
Nerve sheath tumors	9540, 9541, 9550, 9560, 9561, 9570, 9571	9540/3, 9560/3, 9561/3, 9571/3	9540/0,1, 9541/0, 9550/0, 9560/0, 1, 9570/0, 9571/0
Vestibular schwannoma (acoustic neuroma)	*9560*	*None*	*9560/0*
Other tumors of cranial and spinal nerves	9562	*None*	9562/0
Tumors of Meninges			
Meningioma	9530–9534, 9537–9539	9530/3, 9538/3, 9539/3	9530/0,1, 9531/0, 9532/0, 9533/0, 9534/0, 9537/0, 9538/1, 9539/1
Mesenchymal tumors	8324, 8800–8806, 8810, 8815, 8824, 8830, 8831, 8835, 8836, 8850–8854, 8857, 8861, 8870, 8880, 8890, 8897, 8900–8902, 8910, 8912, 8920, 8921, 8935, 8990, 9040, 9136, 9150, 9170, 9180, 9210, 9241, 9260, 9373	8800/3, 8801/3, 8802/3, 8803/3, 8804/3, 8805/3, 8806/3, 8810/3, 8815/3, 8830/3, 8850/3, 8851/3, 8852/3, 8853/3, 8854/3, 8857/3, 8890/3, 8900/3, 8901/3, 8902/3, 8910/3, 8912/3, 8920/3, 8921/3, 8990/3, 9040/3, 9150/3, 9170/3, 9180/3, 9260/3	8324/0, 8800/0, 8810/0, 8815/0, 8824/0,1, 8830/0,1, 8831/0, 8835/1, 8836/1, 8850/0,1, 8851/0, 8852/0, 8854/0, 8857/0, 8861/0, 8870/0, 8880/0, 8890/0,1, 8897/1, 8900/0, 8920/1, 8935/0,1, 8990/0,1, 9040/0, 9136/1, 9150/0,1, 9170/0, 9180/0, 9210/0, 9241/0, 9373/0
Primary melanocytic lesions	8720, 8728, 8770, 8771	8720/3, 8728/3, 8770/3, 8771/3	8728/0,1, 8770/0, 8771/0

Table 2 Continued

Histology	ICD-O-3[a] Histology Codes[b]	ICD-O-3[a] Histology and Behavior Code[b]	
		Malignant (ICD-O-3 Behavior code /3)	Non-Malignant (ICD-O-3 Behavior Codes /0 and /1)
Other neoplasms related to the meninges	9161, 9220, 9231, 9240, 9243, 9370–9372, 9535	9220/3, 9231/3, 9240/3, 9243/3, 9370/3, 9371/3, 9372/3	9161/1, 9220/0,1, 9535/0
Lymphomas and Hematopoietic Neoplasms			
Lymphoma	9590, 9591, 9596, 9650–9655, 9659, 9661–9665, 9667, 9670, 9671, 9673, 9675, 9680, 9684, 9687, 9690, 9691, 9695, 9698, 9699, 9701, 9702, 9705, 9714, 9719, 9728, 9729	9590/3, 9591/3, 9596/3, 9650/3, 9651/3, 9652/3, 9653/3, 9654/3, 9655/3, 9659/3, 9661/3, 9662/3, 9663/3, 9664/3, 9665/3, 9667/3, 9670/3, 9671/3, 9673/3, 9675/3, 9680/3, 9684/3, 9687/3, 9690/3, 9691/3, 9695/3, 9698/3, 9699/3, 9701/3, 9702/3, 9705/3, 9714/3, 9719/3, 9728/3, 9729/3	*None*
Other hematopoietic neoplasms	9727, 9731, 9733, 9734, 9740, 9741, 9750–9758, 9760, 9766, 9823, 9826, 9827, 9832, 9837, 9860, 9861, 9866, 9930, 9970	9727/3, 9731/3, 9733/3, 9734/3, 9740/3, 9741/3, 9750/3, 9754/3, 9755/3, 9756/3, 9757/3, 9758/3, 9760/3, 9823/3, 9826/3, 9827/3, 9832/3, 9837/3, 9860/3, 9861/3, 9866/3, 9930/3	9740/1, 9751/1, 9752/1, 9753/1, 9766/1, 9970/1
Germ Cell Tumors and Cysts			
Germ cell tumors, cysts, and heterotopias	8020, 8440, 9060, 9061, 9064, 9065, 9070–9072, 9080–9085, 9100, 9101	8020/3, 8440/3, 9060/3, 9061/3, 9064/3, 9065/3, 9070/3, 9071/3, 9072/3, 9080/3, 9081/3, 9082/3, 9083/3, 9084/3, 9085/3, 9100/3, 9101/3	8440/0, 9080/0,1, 9084/0
Tumors of Sellar Region			
Tumors of the pituitary	8040, 8140, 8146, 8246, 8260, 8270–8272, 8280, 8281, 8290, 8300, 8310, 8323, 9492 (Site C75.1 only), 9582	8140/3, 8246/3, 8260/3, 8270/3, 8272/3, 8280/3, 8281/3, 8290/3, 8300/3, 8310/3, 8323/3	8040/0,1, 8140/0,1, 8146/0, 8260/0, 8270/0, 8271/0, 8272/0, 8280/0, 8281/0, 8290/0, 8300/0, 8310/0, 8323/0, 9492/0 (site C75.1 only), 9582/0
Pituitary adenoma	*8272*	*None*	*8272/0*
Craniopharyngioma	9350, 9351, 9352	*None*	9350/1, 9351/1, 9352/1
Unclassified Tumors			
Hemangioma	9120–9123, 9125, 9130, 9131, 9133, 9140	9120/3, 9130/3, 9133/3, 9140/3	9120/0, 9121/0, 9122/0, 9123/0, 9125/0, 9130/0,1, 9131/0, 9133/1
Neoplasm, unspecified	8000–8005, 8010, 8021	8000/3, 8001/3, 8002/3, 8003/3, 8004/3, 8005/3, 8010/3, 8021/3	8000/0,1, 8001/0,1, 8005/0, 8010/0
All other	8320, 8452, 8710, 8711, 8713, 8811, 8840, 8896, 8980, 9173, 9503, 9580	8320/3, 8710/3, 8711/3, 8811/3, 8840/3, 8896/3, 8980/3, 9503/3, 9580/3	8452/1, 8711/0, 8713/0, 8811/0, 8840/0, 9173/0, 9580/0

a.International Classification of Diseases for Oncology, 3rd Edition, 2000. World Health Organization, Geneva, Switzerland.
b.See the CBTRUS website for additional information about the specific histology codes included in each group: http://www.cbtrus.org.
c.Histology only included starting with diagnosis year 2015.
d.While the WHO classification of CNS tumors classifies pilocytic astrocytoma as a non-malignant tumor, this histology has been historically included as a malignant histology for the purposes of mandatory reporting in US cancer registration. As a result of this, CBTRUS classifies pilocytic astrocytoma as a malignant tumor for comparability with both historical data and other reporting sources.
e.ICD-O-3histology and behavior Codes 9442/3 only.
f.ICD-O-3 histology and behavior Codes 9442/1 only.
** All or some of this histology is included in the CBTRUS definition of gliomas, including ICD-O-3 histology codes 9380–9384 and 9391–9460. All or some of the histologies listed under Glioma, NOS are 2007 WHO Classification new histologies that had not been fully implemented in collection practices during the years covered in this report but were re-coded to existing ICD-O-3 histology codes. Starting January 1, 2018, these ICD-O-3 codes are fully implemented.*
Abbreviations: CBTRUS, Central Brain Tumor Registry of the United States; NOS, Not otherwise specified

Table 3 Five-year total, annual average total[a], and average annual age-adjusted incidence rates[b] with 95% confidence intervals for all brain and other central nervous system tumors by major histology grouping, histology, behavior, and sex, CBTRUS Statistical Report: U.S. Cancer Statistics – NPCR and SEER, 2012–2016

Histology	Total						Male						Female					
	5 year Total	Annual average	% of all tumors	Median Age	Rate	95% CI	5 year Total	Annual average	% Malignant	% Non-Malignant	Rate	95% CI	5 year Total	Annual average	% Malignant	% Non-Malignant	Rate	95% CI
Tumors of Neuroepithelial Tissue	**112,280**	**22,456**	**27.7%**	**57.0**	**6.56**	**6.52–6.60**	**62,981**	**12,596**	**92.8%**	**7.2%**	**7.69**	**7.62–7.75**	**49,299**	**9,860**	**92.3%**	**7.7%**	**5.56**	**5.51–5.61**
Pilocytic Astrocytoma	5,166	1,033	1.3%	12.0	0.35	0.34–0.36	2,686	537	100.0%	0.0%	0.36	0.34–0.37	2,480	496	100.0%	0.0%	0.34	0.33–0.36
Diffuse Astrocytoma	7,500	1,500	1.8%	47.0	0.46	0.45–0.47	4,127	825	100.0%	0.0%	0.52	0.50–0.53	3,373	675	100.0%	0.0%	0.40	0.39–0.42
Anaplastic Astrocytoma	7,015	1,403	1.7%	53.0	0.42	0.41–0.43	3,868	774	100.0%	0.0%	0.48	0.46–0.49	3,147	629	100.0%	0.0%	0.36	0.35–0.37
Unique Astrocytoma Variants	1,161	232	0.3%	23.0	0.07	0.07–0.08	628	126	68.3%	31.7%	0.08	0.08–0.09	533	107	66.8%	33.2%	0.07	0.06–0.07
Malignant	*785*	*157*	*0.2%*	*32.0*	*0.05*	*0.05-0.05*	*429*	*86*	--	--	*0.05*	*0.05–0.06*	*356*	*71*	--	--	*0.04*	*0.04–0.05*
Non-Malignant	*376*	*75*	*0.1%*	*10.0*	*0.03*	*0.02–0.03*	*199*	*40*	--	--	*0.03*	*0.02–0.03*	*177*	*35*	--	--	*0.02*	*0.02–0.03*
Glioblastoma	59,164	11,833	14.6%	65.0	3.22	3.19–3.24	34,149	6,830	100.0%	0.0%	4.00	3.96–4.05	25,015	5,003	100.0%	0.0%	2.54	2.51–2.57
Oligodendroglioma	3,668	734	0.9%	43.0	0.23	0.22–0.24	2,006	401	100.0%	0.0%	0.26	0.25–0.27	1,662	332	100.0%	0.0%	0.21	0.20–0.22
Anaplastic Oligodendroglioma	1,808	362	0.4%	50.0	0.11	0.10–0.11	1,000	200	100.0%	0.0%	0.12	0.12–0.13	808	162	99.9%	0.1%	0.10	0.09–0.10
Oligoastrocytic Tumors	2,103	421	0.5%	41.0	0.13	0.13–0.14	1,208	242	100.0%	0.0%	0.15	0.15–0.16	895	179	99.9%	0.1%	0.11	0.10–0.12
EpendymalTumors	6,877	1,375	1.7%	45.0	0.43	0.41–0.44	3,913	783	55.9%	44.1%	0.49	0.47–0.50	2,964	593	61.3%	38.7%	0.37	0.35–0.38
Malignant	*4,005*	*801*	*1.0%*	*23.0*	*0.25*	*0.24–0.26*	*2,189*	*438*	--	--	*0.28*	*0.26–0.29*	*1,816*	*363*	--	--	*0.23*	*0.22–0.24*
Non-Malignant	*2,872*	*574*	*0.7%*	*47.0*	*0.17*	*0.17–0.18*	*1,724*	*345*	--	--	*0.21*	*0.20–0.22*	*1,148*	*230*	--	--	*0.14*	*0.13–0.15*
Glioma Malignant, NOS	7,751	1,550	1.9%	36.0	0.49	0.47–0.50	3,920	784	100.0%	0.0%	0.51	0.49–0.53	3,831	766	100.0%	0.0%	0.47	0.45–0.48
Choroid Plexus Tumors	817	163	0.2%	19.0	0.05	0.05–0.06	412	82	16.0%	84.0%	0.05	0.05–0.06	405	81	16.0%	84.0%	0.05	0.05–0.06
Malignant	*131*	*26*	*0.0%*	*2.0*	*0.01*	*0.01-0.01*	*66*	*13*	--	--	*0.01*	*0.01-0.01*	*65*	*13*	--	--	*0.01*	*0.01-0.01*
Non-Malignant	*686*	*137*	*0.2%*	*23.5*	*0.04*	*0.04–0.05*	*346*	*69*	--	--	*0.04*	*0.04–0.05*	*340*	*68*	--	--	*0.04*	*0.04–0.05*
Other Neuroepithelial Tumors	109	22	0.0%	30.0	0.01	0.01-0.01	40	8	47.5%	52.5%	0.01	0.00–0.01	69	14	76.8%	23.2%	0.01	0.01-0.01
Malignant	*72*	*14*	*0.0%*	*26.5*	*0.00*	*0.00–0.01*	*19*	*4*	--	--	*0.00*	*0.00-0.00*	*53*	*11*	--	--	*0.01*	*0.01-0.01*
Non-Malignant	*37*	*7*	*0.0%*	*38.0*	*0.00*	*0.00-0.00*	*21*	*4*	--	--	*0.00*	*0.00-0.00*	*16*	*3*	--	--	*0.00*	*0.00-0.00*

Table 3 Continued

Histology	Total						Male						Female					
	5 year Total	Annual average	% of all tumors	Median Age	Rate	95% CI	5 year Total	Annual average	% Malignant	% Non-Malignant	Rate	95% CI	5 year Total	Annual average	% Malignant	% Non-Malignant	Rate	95% CI
Neuronal and Mixed Neuronal Glial Tumors	4,852	970	1.2%	27.0	0.31	0.30–0.32	2,640	528	21.6%	78.4%	0.34	0.33–0.35	2,212	442	18.4%	81.6%	0.29	0.27–0.30
Malignant	*976*	*195*	*0.2%*	*53.0*	*0.06*	*0.05–0.06*	*570*	*114*	--	--	*0.07*	*0.06–0.08*	*406*	*81*	--	--	*0.05*	*0.04–0.05*
Non-Malignant	*3,876*	*775*	*1.0%*	*22.0*	*0.25*	*0.25–0.26*	*2,070*	*414*	--	--	*0.27*	*0.26–0.28*	*1,806*	*361*	--	--	*0.24*	*0.23–0.25*
Tumors of the Pineal Region	796	159	0.2%	34.5	0.05	0.05-0.05	340	68	67.9%	32.1%	0.04	0.04–0.05	456	91	46.9%	53.1%	0.06	0.05–0.06
Malignant	*445*	*89*	*0.1%*	*27.0.*	*0.03*	*0.03-0.03*	*231*	*46*	--	--	*0.03*	*0.03-0.03*	*214*	*43*	--	--	*0.03*	*0.02–0.03*
Non-Malignant	*351*	*70*	*0.1%*	*42.0*	*0.02*	*0.02-0.02*	*109*	*22*	--	--	*0.01*	*0.01–0.02*	*242*	*48*	--	--	*0.03*	*0.03-0.03*
EmbryonalTumors	3,493	699	0.9%	8.0	0.24	0.23–0.24	2044	409	97.8%	2.2%	0.27	0.26–0.29	1,449	290	95.7%	4.3%	0.20	0.19–0.21
Tumors of Cranial and Spinal Nerves	**35,053**	**7,011**	**8.6%**	**56**	**2.01**	**1.99–2.03**	**16,811**	**3,362**	**0.7%**	**99.3%**	**2.01**	**1.98–2.04**	**18,242**	**3,648**	**0.7%**	**99.3%**	**2.02**	**1.99–2.05**
Nerve Sheath Tumors	35,017	7,003	8.6%	56.0	2.01	1.99–2.03	16,789	3,358	0.7%	99.3%	2.01	1.98–2.04	18,228	3,646	0.7%	99.3%	2.02	1.99–2.05
Malignant	*231*	*46*	0.1%	*53.0*	*0.01*	*0.01–0.02*	*112*	*22*	--	--	*0.01*	*0.01–0.02*	*119*	*24*	--	--	*0.01*	*0.01–0.02*
Non-Malignant	*34,786*	*6,957*	8.6%	*56.0*	*1.99*	*1.97–2.02*	*16,677*	*3,335*	--	--	*1.99*	*1.96–2.02*	*18,109*	*3,622*	--	--	*2.00*	*1.97–2.03*
OtherTumors of Cranial and Spinal Nerves	36	7	0.0%	54.0	0.00	0.00-0.00	22	4	0.0%	100.0%	0.00	0.00-0.00	--	--	0.0%	100.0%	--	--
Tumors of Meninges	**157,310**	**31,462**	**38.8%**	**65.0**	**8.83**	**8.79–8.88**	**43,396**	**8,679**	**2.8%**	**97.2%**	**5.37**	**5.32–5.42**	**113,914**	**22,783**	**1.2%**	**98.8%**	**11.89**	**11.82–11.96**
Meningioma	152,756	30,551	37.6%	66.0	8.56	8.51–8.60	41,032	8,206	1.9%	98.1%	5.08	5.03–5.13	111,724	22,345	0.9%	99.1%	11.63	11.56–11.70
Malignant	*1,774*	*355*	*0.4%*	*65.0*	*0.10*	*0.09–0.10*	*772*	*154*	--	--	*0.09*	*0.09–0.10*	*1,002*	*200*	--	--	*0.10*	*0.10–0.11*
Non-Malignant	*150,982*	*30,196*	*37.2%*	*66.0*	*8.46*	*8.42–8.50*	*40,260*	*8,052*	--	--	*4.98*	*4.93–5.03*	*110,722*	*22,144*	--	--	*11.53*	*11.46–11.60*
Mesenchymal Tumors	1,433	287	0.4%	49.0	0.09	0.08–0.09	705	141	34.5%	65.5%	0.09	0.08–0.10	728	146	28.7%	71.3%	0.09	0.08–0.09
Primary Melanocytic Lesions	109	22	0.0%	57.0	0.01	0.01-0.01	61	12	82.0%	18.0%	0.01	0.01-0.01	48	10	58.3%	41.7%	0.01	0.00–0.01
Other Neoplasms Related to the Meninges	3,012	602	0.7%	49.0	0.18	0.17–0.19	1,598	320	8.6%	91.4%	0.20	0.19–0.21	1,414	283	8.7%	91.3%	0.17	0.16–0.18
Lymphomas and Hematopoietic Neoplasms	**7,914**	**1,583**	**2.0%**	**66.0**	**0.44**	**0.43–0.45**	**4,018**	**804**	**99.9%**	**0.1%**	**0.48**	**0.47–0.50**	**3,896**	**779**	**99.8%**	**0.2%**	**0.40**	**0.39–0.42**
Lymphoma	7,680	1,536	1.9%	66.0	0.43	0.42–0.44	3,881	776	100.0%	0.0%	0.47	0.45–0.48	3,799	760	100.0%	0.0%	0.39	0.38–0.41
Other Hematopoietic Neoplasms	234	47	0.1%	43.0	0.01	0.01–0.02	137	27	95.6%	4.4%	0.02	0.01–0.02	97	19	91.8%	8.2%	0.01	0.01-0.01

Table 3 Continued

Histology	Total						Male						Female					
	5 year Total	Annual average	% of all tumors	Median Age	Rate	95% CI	5 year Total	Annual average	% Malignant	% Non-Malignant	Rate	95% CI	5 year Total	Annual average	% Malignant	% Non-Malignant	Rate	95% CI
Germ Cell Tumors and Cysts	**1,543**	**309**	**0.4%**	**16.0**	**0.10**	**0.10–0.11**	**1,056**	**211**	**75.8%**	**24.2%**	**0.14**	**0.13–0.15**	**487**	**97**	**48.7%**	**51.3%**	**0.07**	**0.06–0.07**
Germ cell tumors, cysts, and heterotopias	1,543	309	0.4%	16.0	0.10	0.10–0.11	1056	211	75.8%	24.2%	0.14	0.13–0.15	487	97	48.7%	51.3%	0.07	0.06–0.07
Malignant	*1,037*	*207*	*0.3%*	*15.0*	*0.07*	*0.07-0.07*	*800*	*160*	--	--	*0.10*	*0.10–0.11*	*237*	*47*	--	--	*0.03*	*0.03–0.04*
Non-Malignant	*506*	*101*	*0.1%*	*25.5*	*0.03*	*0.03–0.04*	*256*	*51*	--	--	*0.03*	*0.03–0.04*	*250*	*50*	--	--	*0.03*	*0.03–0.04*
Tumors of Sellar Region	**71,084**	**14,217**	17.5%	**51.0**	**4.27**	**4.24–4.31**	**32,262**	**6,452**	**0.3%**	**99.7%**	**3.94**	**3.89–3.98**	**38,822**	**7,764**	**0.2%**	**99.8%**	**4.69**	**4.65–4.74**
Tumors of the Pituitary	68,020	13,604	16.8%	51.0	4.08	4.05–4.12	30,726	6,145	0.3%	99.7%	3.74	3.70–3.79	37,294	7,459	0.2%	99.8%	4.51	4.46–4.56
Malignant	*157*	*31*	*0.0%*	*57.0*	*0.01*	*0.01-0.01*	*89*	*18*	--	--	*0.01*	*0.01-0.01*	*68*	*14*	--	--	*0.01*	*0.01-0.01*
Non-Malignant	*67,863*	*13,573*	*16.7%*	*51.0*	*4.07*	*4.04–4.11*	*30,637*	*6,127*	--	--	*3.73*	*3.69–3.78*	*37,226*	*7,445*	--	--	*4.50*	*4.45–4.55*
Craniopharyngioma	3,064	613	0.8%	43.0	0.19	0.18–0.20	1,536	307	0.7%	99.3%	0.19	0.18–0.20	1,528	306	0.2%	99.8%	0.19	0.18–0.20
Unclassified Tumors	**20,556**	**4,111**	5.1%	**63.0**	**1.19**	**1.18–1.21**	**9,344**	**1,869**	**34.6%**	**65.4%**	**1.19**	**1.17–1.22**	**11,212**	**2,242**	**30.8%**	**69.2%**	**1.21**	**1.19–1.23**
Hemangioma	5,982	1,196	1.5%	50.0	0.36	0.35–0.37	2,600	520	0.3%	99.7%	0.32	0.31–0.34	3,382	676	0.3%	99.7%	0.40	0.38–0.41
Neoplasm Unspecified	14,418	2,884	3.6%	69.0	0.83	0.81–0.84	6,647	1,329	48.2%	51.8%	0.86	0.84–0.88	7,771	1,554	44.1%	55.9%	0.81	0.79–0.82
Malignant	*6,634*	*1,327*	*1.6%*	*76.0*	*0.37*	*0.36–0.38*	*3,205*	*641*	--	--	*0.42*	*0.40–0.43*	*3,429*	*686*	--	--	*0.34*	*0.32–0.35*
Non-Malignant	*7,784*	*1,557*	*1.9%*	*63.0*	*0.45*	*0.44–0.46*	*3,442*	*688*	--	--	*0.44*	*0.43–0.46*	*4,342*	*868*	--	--	*0.47*	*0.45–0.48*
All Other	156	31	0.0%	67.0	0.01	0.01-0.01	97	19	23.7%	76.3%	0.01	0.01–0.02	59	12	32.2%	67.8%	0.01	0.01-0.01
TOTAL[c]	**405,740**	**81,148**	**100%**	**60.0**	**23.41**	**23.34–23.49**	**169,868**	**33,974**	**40%**	**60%**	**20.82**	**20.72–20.92**	**235,872**	**47,174**	**23.2%**	**76.8%**	**25.84**	**25.73–25.95**
Malignant	***122,569***	***24,514***	***30.2%***	***60.0***	***7.08***	***7.04–7.12***	***67,930***	***13,586***	--	--	***8.29***	***8.23–8.35***	***54,639***	***10,928***	--	--	***6.02***	***5.97–6.07***
Non-Malignant	***283,171***	***56,634***	***69.8%***	***60.0***	***16.33***	***16.27–16.39***	***101,938***	***20,388***	--	--	***12.53***	***12.45–12.61***	***181,233***	***36,247***	--	--	***19.82***	***19.73–19.91***

a. Annual average cases are calculated by dividing the five-year total by five.
b. Rates are per 100,000 and are age-adjusted to the 2000 US standard population.
c. Refers to all brain tumors including histologies not presented in this table.
-- Counts and rates are not presented when fewer than 16 cases were reported for the specific category, or where the inclusion of the count and rate would allow for back-calculation of suppressed values. The suppressed cases are included in the counts and rates for Totals.
Abbreviations: CBTRUS, Central Brain Tumor Registry of the United States; NPCR, National Program of Cancer Registries; SEER, Surveillance, Epidemiology, and End Results Program; CI, Confidence Interval; NOS, Not otherwise specified

Table 4 Five-year total, annual average total[a], and average annual age-adjusted incidence rates[b] with 95% confidence intervals for selected non-malignant brain and other central nervous system histologies by sex, age-groups, race, and ethnicity, CBTRUS Statistical Reportt: NPCR and SEER, 2012–2016

Group	Vestibular Schwannoma[c]				Pituitary Adenoma[d]				WHO Grade I Meningioma[e]				WHO Grade II Meningioma[f]			
	5-Year Total	Annual Average	Rate	95% CI	5-Year Total	Annual Average	Rate	95% CI	5-Year Total	Annual Average	Rate	95% CI	5-Year Total	Annual Average	Rate	95% CI
Male	15,868	3,174	1.89	1.86–1.92	26,537	5,307	3.23	3.19–3.27	37,301	7,460	4.63	4.58–4.67	2,959	592	0.36	0.34–0.37
Female	17,379	3,476	1.91	1.88–1.94	31,893	6,379	3.84	3.80–3.88	106,423	21,285	11.06	10.99–11.13	4,299	860	0.47	0.45–0.48
0–14 years	290	58	0.10	0.08–0.11	787	157	0.26	0.24–0.28	197	39	0.06	0.06–0.07	73	15	0.02	0.02–0.03
15–39 years	4,942	988	0.96	0.93–0.99	16,599	3,320	3.15	3.10–3.20	8315	1,663	1.67	1.64–1.71	827	165	0.16	0.15–0.17
40–64 years	18,137	3,627	3.29	3.24–3.34	25,604	5,121	4.83	4.77–4.89	57,454	11,491	10.18	10.09–10.26	3,387	677	0.61	0.59–0.63
65+ years	9,878	1,976	4.24	4.16–4.33	15,440	3,088	6.75	6.65–6.86	77,758	15,552	34.38	34.13–34.62	2,971	594	1.30	1.26–1.35
White	28,481	5,696	2.00	1.98–2.03	42,232	8,446	3.16	3.13–3.19	117,347	23,469	7.88	7.84–7.93	5,687	1,137	0.39	0.38–0.41
Black	1,900	380	0.91	0.87–0.95	11,425	2,285	5.58	5.48–5.69	17,723	3,545	9.25	9.11–9.39	1,061	212	0.53	0.50–0.57
American Indian/ Alaska Native	207	41	1.02	0.88–1.17	502	100	2.54	2.32–2.79	860	172	5.18	4.81–5.56	32	6	0.19	0.13–0.28
Asian or Pacific Islander	1,860	372	1.89	1.80–1.98	3,063	613	3.14	3.03–3.26	5,946	1,189	6.72	6.54–6.89	371	74	0.39	0.35–0.43
Non-Hispanic	30,369	6,074	1.99	1.97–2.01	49,190	9,838	3.43	3.40–3.46	129,882	25,976	8.13	8.08–8.17	6,602	1,320	0.43	0.42–0.44
Hispanic	2,878	576	1.32	1.27–1.37	9,240	1,848	3.97	3.88–4.05	13,842	2,768	7.70	7.56–7.83	656	131	0.32	0.30–0.35
TOTAL	**33,247**	**6,649**	**1.90**	**1.88–1.92**	**58,430**	**11,686**	**3.50**	**3.47–3.53**	**143,724**	**28,745**	**8.05**	**8.00–8.09**	**7,258**	**1,452**	**0.41**	**0.40–0.42**

a. Annual average cases are calculated by dividing the five-year total by five.
b. Rates are per 100,000 and are age-adjusted to the 2000 US standard population.
c. ICD-O-3 histology code 9560/0.
d. ICD-O-3 histology code 8272/0 and ICD-O-3 topography code C75.1.
e. ICD-O-3 histology codes 9530/0, 9531/0, 9532/0, 9533/0, 9534/0, and 9537/0.
f. ICD-O-3 histology codes 9530/1, 9531/1, 9532/1, 9533/1, 9534/1, 9537/1, 9538/1, and 9539/1.
- Counts and rates are not presented when fewer than 16 cases were reported for the specific category. The suppressed cases are included in the counts and rates for Totals.
Abbreviations: CBTRUS, Central Brain Tumor Registry of the United States; NPCR, National Program of Cancer Registries; SEER, Surveillance, Epidemiology, and End Results Program; CI, Confidence Interval; NOS, Not otherwise specified

Table 5 Five-year total, annual average total[a], and average annual age-adjusted incidence rates[b] with 95% confidence intervals of all brain and other central nervous system tumors by major histology grouping, histology, and NCI age-groups, CBTRUS Statistical Report: U.S. Cancer Statistics – NPCR and SEER, 2012–2016

Histology	Age at Diagnosis											
	Children[c] (Age 0–14 Years)				AYA[d] (Age 15–39 Years)				Adults (Age 40+ Years)			
	5-year Total	Annual Average	Rate	95% CI	5-year Total	Annual Average	Rate	95% CI	5-year Total	Annual Average	Rate	95% CI
Tumors of Neuroepithelial Tissue	**12,693**	**2,539**	**4.15**	**4.08–4.23**	**18,297**	**3,659**	**3.46**	**3.41–3.51**	**81,290**	**16,258**	**10.31**	**10.24–10.39**
Pilocytic Astrocytoma	3,118	624	1.02	0.98–1.06	1,463	293	0.27	0.26–0.28	585	117	0.08	0.07–0.09
Diffuse Astrocytoma	708	142	0.23	0.21–0.25	2,316	463	0.44	0.42–0.45	4,476	895	0.59	0.57–0.60
Anaplastic Astrocytoma	292	58	0.10	0.09–0.11	1,793	359	0.34	0.32–0.35	4,930	986	0.64	0.62–0.66
Unique Astrocytoma Variants	402	80	0.13	0.12–0.15	394	79	0.07	0.07–0.08	365	73	0.05	0.04–0.05
Malignant	*162*	*32*	*0.05*	*0.05–0.06*	*292*	*58*	*0.05*	*0.05–0.06*	*331*	*66*	*0.04*	*0.04–0.05*
Non-Malignant	*240*	*48*	*0.08*	*0.07–0.09*	*102*	*20*	*0.02*	*0.02-0.02*	*34*	*7*	*0.00*	*0.00–0.01*
Glioblastoma	503	101	0.17	0.15–0.18	2,713	543	0.53	0.51–0.55	55,948	11,190	6.95	6.89–7.01
Oligodendroglioma	101	20	0.03	0.03–0.04	1,429	286	0.27	0.26–0.29	2,138	428	0.30	0.28–0.31
Anaplastic Oligodendroglioma	--	--	--	--	465	93	0.09	0.08–0.10	1,332	266	0.18	0.17–0.19
Oligoastrocytic Tumors	47	9	0.02	0.01–0.02	920	184	0.17	0.16–0.19	1,136	227	0.16	0.15–0.17
Ependymal Tumors	934	187	0.31	0.29–0.33	1,932	386	0.37	0.35–0.38	4,011	802	0.53	0.52–0.55
Malignant	*822*	*164*	*0.27*	*0.25–0.29*	*1,055*	*211*	*0.20*	*0.19–0.21*	*2,128*	*426*	*0.28*	*0.27–0.30*
Non-Malignant	*112*	*22*	*0.04*	*0.03–0.04*	*877*	*175*	*0.17*	*0.16–0.18*	*1,883*	*377*	*0.25*	*0.24–0.26*
Glioma Malignant, NOS	2,456	491	0.80	0.77–0.84	1,599	320	0.30	0.28–0.31	3,696	739	0.48	0.47–0.50
Choroid Plexus Tumors	360	72	0.12	0.11–0.13	216	43	0.04	0.04–0.05	241	48	0.03	0.03–0.04
Malignant	*102*	*20*	*0.03*	*0.03–0.04*	--	--	--	--	*16*	*3*	*0.00*	*0.00-0.00*
Non-Malignant	*258*	*52*	*0.08*	*0.07–0.10*	--	--	--	--	*225*	*45*	*0.03*	*0.03-0.03*
Other Neuroepithelial Tumors	31	6	0.01	0.01-0.01	35	7	0.01	0.00–0.01	43	9	0.01	0.00–0.01
Malignant	--	--	--	--	--	--	--	--	*26*	*5*	*0.00*	*0.00–0.01*
Non-Malignant	--	--	--	--	--	--	--	--	*17*	*3*	*0.00*	*0.00-0.00*
Neuronal and Mixed Neuronal Glial Tumors	1,278	256	0.42	0.40–0.44	1,903	381	0.35	0.34–0.37	1,671	334	0.23	0.21–0.24
Malignant	*65*	*13*	*0.02*	*0.02–0.03*	*199*	*40*	*0.04*	*0.03–0.04*	*712*	*142*	*0.09*	*0.09–0.10*
Non-Malignant	*1,213*	*243*	*0.40*	*0.38–0.42*	*1,704*	*341*	*0.32*	*0.30–0.33*	*959*	*192*	*0.13*	*0.12–0.14*
Tumors of the Pineal Region	158	32	0.05	0.04–0.06	293	59	0.05	0.05–0.06	345	69	0.05	0.04–0.05
Malignant	*138*	*28*	*0.05*	*0.04–0.05*	*155*	*31*	*0.03*	*0.02–0.03*	*152*	*30*	*0.02*	*0.02-0.02*
Non-Malignant	*20*	*4*	*0.01*	*0.00–0.01*	*138*	*28*	*0.03*	*0.02–0.03*	*193*	*39*	*0.03*	*0.02–0.03*

Table 5 Continued

Histology	Age at Diagnosis											
	Children[c] (Age 0–14 Years)				AYA[d] (Age 15–39 Years)				Adults (Age 40+ Years)			
	5-year Total	Annual Average	Rate	95% CI	5-year Total	Annual Average	Rate	95% CI	5-year Total	Annual Average	Rate	95% CI
Embryonal Tumors	2,294	459	0.75	0.72–0.78	826	165	0.15	0.14–0.16	373	75	0.05	0.05–0.06
Medulloblastoma	*1,475*	*295*	*0.48*	*0.46–0.51*	*596*	*119*	*0.11*	*0.10–0.12*	*163*	*33*	*0.02*	*0.02–0.03*
Primitive Neuroectodermal Tumors	*239*	*48*	*0.08*	*0.07–0.09*	*129*	*26*	*0.02*	*0.02–0.03*	*124*	*25*	*0.02*	*0.01–0.02*
Atypical Teratoid/Rhabdoid Tumor	*365*	*73*	*0.12*	*0.11–0.13*	*23*	*5*	*0.00*	*0.00–0.01*	--	--	--	--
Other Embryonal Histologies[e]	*215*	*43*	*0.07*	*0.06–0.08*	*78*	*16*	*0.01*	*0.01–0.02*	--	--	--	--
Tumors of Cranial and Spinal Nerves	**862**	**172**	**0.28**	**0.26–0.30**	**5,325**	**1,065**	**1.03**	**1.01–1.06**	**28,866**	**5,773**	**3.68**	**3.64–3.72**
Nerve Sheath Tumors	862	172	0.28	0.26–0.30	5,316	1,063	1.03	1.00–1.06	28,839	5,768	3.68	3.63–3.72
Malignant	--	--	--	--	*49*	*10*	*0.01*	*0.01-0.01*	*170*	*34*	*0.02*	*0.02–0.03*
Non-Malignant	--	--	--	--	*5,267*	*1,053*	*1.02*	*0.99–1.05*	*28,669*	*5,734*	*3.65*	*3.61–3.70*
Other Tumors of Cranial and Spinal Nerves	--	--	--	--	--	--	--	--	27	5	0.00	0.00–0.01
Tumors of Meninges	**563**	**113**	**0.18**	**0.17–0.20**	**10,583**	**2,117**	**2.11**	**2.07–2.15**	**146,164**	**29,233**	**18.69**	**18.59–18.79**
Meningioma	293	59	0.10	0.09–0.11	9,260	1,852	1.86	1.82–1.90	143,203	28,641	18.30	18.21–18.40
Malignant	*23*	*5*	*0.01*	*0.00–0.01*	*118*	*24*	*0.02*	*0.02–0.03*	*1,633*	*327*	*0.21*	*0.20–0.22*
Non-Malignant	*270*	*54*	*0.09*	*0.08–0.10*	*9,142*	*1,828*	*1.84*	*1.80–1.87*	*141,570*	*28,314*	*18.10*	*18.00–18.19*
Mesenchymal Tumors	203	41	0.07	0.06–0.08	342	68	0.06	0.06–0.07	888	178	0.12	0.11–0.12
Primary Melanocytic Lesions	--	--	--	--	16	3	0.00	0.00-0.00	85	17	0.01	0.01-0.01
Other Neoplasms Related to the Meninges	--	--	--	--	965	193	0.18	0.17–0.19	1,988	398	0.26	0.25–0.27
Lymphomas and Hematopoietic Neoplasms	**82**	**16**	**0.03**	**0.02–0.03**	**561**	**112**	**0.11**	**0.10–0.12**	**7,271**	**1,454**	**0.92**	**0.90–0.95**
Lymphoma	30	6	0.01	0.01-0.01	502	100	0.10	0.09–0.11	7,148	1,430	0.91	0.89–0.93
Other Hematopoietic Neoplasms	52	10	0.02	0.01–0.02	59	12	0.01	0.01-0.01	123	25	0.02	0.01–0.02
Germ Cell Tumors and Cysts	**666**	**133**	**0.22**	**0.20–0.24**	**682**	**136**	**0.12**	**0.12–0.13**	**195**	**39**	**0.03**	**0.02–0.03**
Germ cell tumors, cysts, and heterotopias	666	133	0.22	0.20–0.24	682	136	0.12	0.12–0.13	195	39	0.03	0.02–0.03
Malignant	*479*	*96*	*0.16*	*0.14–0.17*	*530*	*106*	*0.10*	*0.09–0.10*	*28*	*6*	*0.00*	*0.00–0.01*
Non-Malignant	*187*	*37*	*0.06*	*0.05–0.07*	*152*	*30*	*0.03*	*0.02–0.03*	*167*	*33*	*0.02*	*0.02–0.03*
Tumors of Sellar Region	1,646	329	0.54	0.52–0.57	20,816	4,163	3.95	3.90–4.00	48,622	9,724	6.40	6.34–6.46
Tumors of the Pituitary	958	192	0.32	0.30–0.34	20,115	4,023	3.82	3.76–3.87	46,947	9,389	6.18	6.13–6.24
Malignant	--	--	--	--	*26*	*5*	*0.01*	*0.00–0.01*	*131*	*26*	*0.02*	*0.01–0.02*
Non-Malignant	--	--	--	--	*20,089*	*4018*	*3.81*	*3.76–3.87*	*46,816*	*9,363*	*6.17*	*6.11–6.22*
Craniopharyngioma	688	138	0.23	0.21–0.24	701	140	0.13	0.12–0.14	1,675	335	0.22	0.21–0.23

Table 5 Continued

Histology	Age at Diagnosis											
	Children[c] (Age 0–14 Years)				AYA[d] (Age 15–39 Years)				Adults (Age 40+ Years)			
	5-year Total	Annual Average	Rate	95% CI	5-year Total	Annual Average	Rate	95% CI	5-year Total	Annual Average	Rate	95% CI
Unclassified Tumors	**1,028**	**206**	**0.34**	**0.32–0.36**	**3,251**	**650**	**0.62**	**0.60–0.64**	**16,277**	**3,255**	**2.10**	**2.07–2.13**
Hemangioma	375	75	0.12	0.11–0.14	1,605	321	0.31	0.29–0.32	4,002	800	0.52	0.51–0.54
Neoplasm Unspecified	623	125	0.20	0.19–0.22	1,632	326	0.31	0.29–0.33	12,163	2,433	1.56	1.53–1.59
Malignant	*174*	*35*	*0.06*	*0.05–0.07*	*373*	*75*	*0.07*	*0.06–0.08*	*6,087*	*1,217*	*0.77*	*0.75–0.79*
Non-Malignant	*449*	*90*	*0.15*	*0.13–0.16*	*1,259*	*252*	*0.24*	*0.23–0.25*	*6,076*	*1,215*	*0.79*	*0.77–0.81*
All Other	30	6	0.01	0.01-0.01	--	--	--	--	112	22	0.01	0.01–0.02
TOTAL[f]	**17,540**	**3,508**	**5.74**	**5.66–5.83**	**59,515**	**11,903**	**11.40**	**11.31–11.49**	**328,685**	**65,737**	**42.14**	**41.99–42.28**
Malignant	***11,697***	***2,339***	***3.83***	***3.76–3.90***	***17,066***	***3,413***	***3.23***	***3.18–3.28***	***93,806***	***18,761***	***11.88***	***11.80–11.96***
Non-Malignant	***5,843***	***1,169***	***1.92***	***1.87–1.97***	***42,449***	***8,490***	***8.17***	***8.09–8.25***	***234,879***	***46,976***	***30.26***	***30.13–30.38***

a. Annual average cases are calculated by dividing the five-year total by five.
b. Rates are per 100,000 and are age-adjusted to the 2000 US standard population.
c. Children as defined by the National Cancer Institute, see: https://www.cancer.gov/research/areas/childhood.
d. Adolescents and Young Adults (AYA), as defined by the National Cancer Institute, see: https://www.cancer.gov/types/aya.
e. ICD-O-3 histology and behavior codes: 8963/3, 9364/3, 9480/3, 9490/0, 9490/3, 9500/3, 9501/3, and 9502/3.
f. Refers to all brain tumors including histologies not presented in this table.
-- Counts and rates are not presented when fewer than 16 cases were reported for the specific category, or where the inclusion of the count and rate would allow for back-calculation of suppressed values. The suppressed cases are included in the counts and rates for Totals.
Abbreviations: AYA, Adolescents and young adults; CBTRUS, Central Brain Tumor Registry of the United States; NPCR, National Program of Cancer Registries; SEER, Surveillance, Epidemiology, and End Results Program; CI, Confidence Interval; NOS, Not otherwise specified

Table 6 Five-year total, annual average total[a], and average annual age-adjusted incidence rates[b] with 95% confidence intervals for children and adolescents (age 0–19 years), brain and other central nervous system tumors by major histology grouping, histology, and age at diagnosis, CBTRUS Statistical Report: U.S. Cancer Statistics – NPCR and SEER, 2012–2016

Histology	Age at Diagnosis																			
	0–19 Years				0–4 Years				5–9 Years				10–14 Years				15–19 Years			
	5-Year Total	Annual Average	Rate	95% CI	5-Year Total	Annual Average	Rate	95% CI	5-Year Total	Annual Average	Rate	95% CI	5-Year Total	Annual Average	Rate	95% CI	5-Year Total	Annual Average	Rate	95% CI
Tumors of Neuroepithelial Tissue	**15,778**	**3,156**	**3.84**	**3.78–3.90**	**4,972**	**994**	**4.99**	**4.86–5.14**	**4072**	**814**	**3.97**	**3.85–4.10**	**3,649**	**730**	**3.53**	**3.42–3.65**	**3,085**	**617**	**2.91**	**2.81–3.02**
Pilocytic Astrocytoma	3,730	746	0.91	0.88–0.94	1143	229	1.15	1.08–1.22	1068	214	1.04	0.98–1.11	907	181	0.88	0.82–0.94	612	122	0.58	0.53–0.63
Diffuse Astrocytoma	968	194	0.24	0.22–0.25	272	54	0.27	0.24–0.31	197	39	0.19	0.17–0.22	239	48	0.23	0.20–0.26	260	52	0.25	0.22–0.28
Anaplastic Astrocytoma	406	81	0.10	0.09–0.11	69	14	0.07	0.05–0.09	116	23	0.11	0.09–0.14	107	21	0.10	0.08–0.13	114	23	0.11	0.09–0.13
Unique Astrocytoma Variants	519	104	0.13	0.12–0.14	112	22	0.11	0.09–0.14	139	28	0.14	0.11–0.16	151	30	0.15	0.12–0.17	117	23	0.11	0.09–0.13
Malignant	*243*	*49*	*0.06*	*0.05–0.07*	*18*	*4*	*0.02*	*0.01–0.03*	*57*	*11*	*0.06*	*0.04–0.07*	*87*	*17*	*0.08*	*0.07–0.10*	*81*	*16*	*0.08*	*0.06–0.10*
Non-Malignant	*276*	*55*	*0.07*	*0.06–0.08*	*94*	*19*	*0.09*	*0.08–0.12*	*82*	*16*	*0.08*	*0.06–0.10*	*64*	*13*	*0.06*	*0.05–0.08*	*36*	*7*	*0.03*	*0.02–0.05*
Glioblastoma	744	149	0.18	0.17–0.19	124	25	0.12	0.10–0.15	175	35	0.17	0.15–0.20	204	41	0.20	0.17–0.23	241	48	0.23	0.20–0.26
Oligodendroglioma	195	39	0.05	0.04–0.05	20	4	0.02	0.01–0.03	34	7	0.03	0.02–0.05	47	9	0.05	0.03–0.06	94	19	0.09	0.07–0.11
Anaplastic Oligodendroglioma	27	5	0.01	0.00–0.01	--	--	--	--	--	--	--	--	--	--	--	--	16	3	0.02	0.01–0.02
Oligoastrocytic Tumors	84	17	0.02	0.02–0.03	--	--	--	--	18	4	0.02	0.01–0.03	17	3	0.02	0.01–0.03	37	7	0.03	0.02–0.05
Ependymal Tumors	1,173	235	0.29	0.27–0.30	435	87	0.44	0.40–0.48	242	48	0.24	0.21–0.27	257	51	0.25	0.22–0.28	239	48	0.23	0.20–0.26
Malignant	*985*	*197*	*0.24*	*0.22–0.26*	*418*	*84*	*0.42*	*0.38–0.46*	*217*	*43*	*0.21*	*0.18–0.24*	*187*	*37*	*0.18*	*0.16–0.21*	*163*	*33*	*0.15*	*0.13–0.18*
Non-Malignant	*188*	*38*	*0.05*	*0.04–0.05*	*17*	*3*	*0.02*	*0.01–0.03*	*25*	*5*	*0.02*	*0.02–0.04*	*70*	*14*	*0.07*	*0.05–0.09*	*76*	*15*	*0.07*	*0.06–0.09*
Glioma Malignant, NOS	2,870	574	0.70	0.67–0.73	936	187	0.94	0.88–1.00	902	180	0.88	0.82–0.94	618	124	0.60	0.55–0.65	414	83	0.39	0.35–0.43
Choroid Plexus Tumors	409	82	0.10	0.09–0.11	258	52	0.26	0.23–0.29	52	10	0.05	0.04–0.07	50	10	0.05	0.04–0.06	49	10	0.05	0.03–0.06
Malignant	*105*	*21*	*0.03*	*0.02–0.03*	*85*	*17*	*0.09*	*0.07–0.11*	--	--	--	--	--	--	--	--	--	--	--	--
Non-Malignant	*304*	*61*	*0.07*	*0.07–0.08*	*173*	*35*	*0.17*	*0.15–0.20*	--	--	--	--	--	--	--	--	--	--	--	--
Other Neuroepithelial Tumors	38	8	0.01	0.01-0.01	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Malignant	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Non-Malignant	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Neuronal and Mixed Neuronal Glial Tumors	1,889	378	0.46	0.44–0.48	332	66	0.33	0.30–0.37	360	72	0.35	0.32–0.39	586	117	0.57	0.52–0.62	611	122	0.58	0.53–0.62
Malignant	*100*	*20*	*0.02*	*0.02–0.03*	*25*	*5*	*0.03*	*0.02–0.04*	*16*	*3*	*0.02*	*0.01–0.03*	*24*	*5*	*0.02*	*0.01–0.03*	*35*	*7*	*0.03*	*0.02–0.05*
Non-Malignant	*1,789*	*358*	*0.43*	*0.41–0.46*	*307*	*61*	*0.31*	*0.27–0.35*	*344*	*69*	*0.34*	*0.30–0.37*	*562*	*112*	*0.54*	*0.50–0.59*	*576*	*115*	*0.54*	*0.50–0.59*

Table 6 Continued

Histology	Age at Diagnosis																			
	0–19 Years				0–4 Years				5–9 Years				10–14 Years				15–19 Years			
	5-Year Total	Annual Average	Rate	95% CI	5-Year Total	Annual Average	Rate	95% CI	5-Year Total	Annual Average	Rate	95% CI	5-Year Total	Annual Average	Rate	95% CI	5-Year Total	Annual Average	Rate	95% CI
Tumors of the Pineal Region	218	44	0.05	0.05–0.06	70	14	0.07	0.05–0.09	43	9	0.04	0.03–0.06	45	9	0.04	0.03–0.06	60	12	0.06	0.04–0.07
Malignant	*180*	*36*	*0.04*	*0.04–0.05*	--	--	--	--	--	--	--	--	--	--	--	--	*42*	*8*	*0.04*	*0.03–0.05*
Non-Malignant	*38*	*8*	*0.01*	*0.01-0.01*	--	--	--	--	--	--	--	--	--	--	--	--	*18*	*4*	*0.02*	*0.01–0.03*
Embryonal Tumors	2,508	502	0.61	0.59–0.64	1,173	235	1.18	1.11–1.25	713	143	0.70	0.65–0.75	408	82	0.40	0.36–0.44	214	43	0.20	0.18–0.23
Medulloblastoma	*1,632*	*326*	*0.40*	*0.38–0.42*	*535*	*107*	*0.54*	*0.49–0.58*	*603*	*121*	*0.59*	*0.54–0.64*	*337*	*67*	*0.33*	*0.29–0.36*	*157*	*31*	*0.15*	*0.13–0.17*
Primitive Neuroectodermal Tumors	*270*	*54*	*0.07*	*0.06–0.07*	*145*	*29*	*0.15*	*0.12–0.17*	*55*	*11*	*0.05*	*0.04–0.07*	*39*	*8*	*0.04*	*0.03–0.05*	*31*	*6*	*0.03*	*0.02–0.04*
Atypical Teratoid/ Rhabdoid Tumor	*370*	*74*	*0.09*	*0.08–0.10*	*322*	*64*	*0.32*	*0.29–0.36*	*30*	*6*	*0.03*	*0.02–0.04*	--	--	--	--	--	--	--	--
Other Embryonal Histologies[c]	*236*	*47*	*0.06*	*0.05–0.07*	*171*	*34*	*0.17*	*0.15–0.20*	*25*	*5*	*0.02*	*0.02–0.04*	*19*	*4*	*0.02*	*0.01–0.03*	*21*	*4*	*0.02*	*0.01–0.03*
Tumors of Cranial and Spinal Nerves	**1,336**	**267**	**0.32**	**0.31–0.34**	**303**	**61**	**0.30**	**0.27–0.34**	**252**	**50**	**0.25**	**0.22–0.28**	**307**	**61**	**0.30**	**0.27–0.33**	**474**	**95**	**0.45**	**0.41–0.49**
Nerve Sheath Tumors	1,333	267	0.32	0.31–0.34	303	61	0.30	0.27–0.34	252	50	0.25	0.22–0.28	307	61	0.30	0.27–0.33	471	94	0.44	0.41–0.49
Malignant	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Non-Malignant	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Other Tumors of Cranial and Spinal Nerves	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Tumors of Meninges	**1,132**	**226**	**0.27**	**0.26–0.29**	**185**	**37**	**0.19**	**0.16–0.22**	**133**	**27**	**0.13**	**0.11–0.15**	**245**	**49**	**0.24**	**0.21–0.27**	**569**	**114**	**0.54**	**0.49–0.58**
Meningioma	653	131	0.16	0.15–0.17	73	15	0.07	0.06–0.09	73	15	0.07	0.06–0.09	147	29	0.14	0.12–0.17	360	72	0.34	0.31–0.38
Malignant	*37*	*7*	*0.01*	*0.01-0.01*	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Non-Malignant	*616*	*123*	*0.15*	*0.14–0.16*	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Mesenchymal Tumors	254	51	0.06	0.05–0.07	105	21	0.11	0.09–0.13	50	10	0.05	0.04–0.06	48	10	0.05	0.03–0.06	51	10	0.05	0.04–0.06
Primary Melanocytic Lesions	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Other Neoplasms Related to the Meninges	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Lymphomas and Hematopoietic Neoplasms	**131**	**26**	**0.03**	**0.03–0.04**	**--**	**--**	**--**	**--**	**37**	**7**	**0.04**	**0.03–0.05**	**30**	**6**	**0.03**	**0.02–0.04**	**49**	**10**	**0.05**	**0.03–0.06**
Lymphoma	64	13	0.02	0.01–0.02	--	--	--	--	--	--	--	--	--	--	--	--	34	7	0.03	0.02–0.04
Other Hematopoietic Neoplasms	67	13	0.02	0.01–0.02	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--

Table 6 Continued

Histology	Age at Diagnosis																			
	0–19 Years				0–4 Years				5–9 Years				10–14 Years				15–19 Years			
	5-Year Total	Annual Average	Rate	95% CI	5-Year Total	Annual Average	Rate	95% CI	5-Year Total	Annual Average	Rate	95% CI	5-Year Total	Annual Average	Rate	95% CI	5-Year Total	Annual Average	Rate	95% CI
Germ Cell Tumors and Cysts	**951**	**190**	**0.23**	**0.22–0.25**	**186**	**37**	**0.19**	**0.16–0.22**	**153**	**31**	**0.15**	**0.13–0.17**	**327**	**65**	**0.32**	**0.28–0.35**	**285**	**57**	**0.27**	**0.24–0.30**
Germ cell tumors, cysts, and heterotopias	951	190	0.23	0.22–0.25	186	37	0.19	0.16–0.22	153	31	0.15	0.13–0.17	327	65	0.32	0.28–0.35	285	57	0.27	0.24–0.30
Malignant	*733*	*147*	*0.18*	*0.17–0.19*	*77*	*15*	*0.08*	*0.06–0.10*	*110*	*22*	*0.11*	*0.09–0.13*	*292*	*58*	*0.28*	*0.25–0.32*	*254*	*51*	*0.24*	*0.21–0.27*
Non-Malignant	*218*	*44*	*0.05*	*0.05–0.06*	*109*	*22*	*0.11*	*0.09–0.13*	*43*	*9*	*0.04*	*0.03–0.06*	*35*	*7*	*0.03*	*0.02–0.05*	*31*	*6*	*0.03*	*0.02–0.04*
Tumors of Sellar Region	4,080	816	0.98	0.95–1.01	179	36	0.18	0.15–0.21	583	117	0.57	0.52–0.62	884	177	0.86	0.80–0.91	2,434	487	2.30	2.21–2.39
Tumors of the Pituitary	3,232	646	0.78	0.75–0.80	40	8	0.04	0.03–0.05	272	54	0.27	0.23–0.30	646	129	0.63	0.58–0.68	2,274	455	2.15	2.06–2.24
Malignant	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Non-Malignant	--	--	--	---	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Craniopharyngioma	848	170	0.21	0.19–0.22	139	28	0.14	0.12–0.16	311	62	0.30	0.27–0.34	238	48	0.23	0.20–0.26	160	32	0.15	0.13–0.18
Unclassified Tumors	**1,523**	**305**	**0.37**	**0.35–0.39**	**354**	**71**	**0.36**	**0.32–0.40**	**287**	**57**	**0.28**	**0.25–0.31**	**387**	**77**	**0.37**	**0.34–0.41**	**495**	**99**	**0.47**	**0.43–0.51**
Hemangioma	601	120	0.15	0.13–0.16	139	28	0.14	0.12–0.17	95	19	0.09	0.08–0.11	141	28	0.14	0.11–0.16	226	45	0.21	0.19–0.24
Neoplasm Unspecified	886	177	0.22	0.20–0.23	199	40	0.20	0.17–0.23	187	37	0.18	0.16–0.21	237	47	0.23	0.20–0.26	263	53	0.25	0.22–0.28
Malignant	*225*	*45*	*0.05*	*0.05–0.06*	*74*	*15*	*0.07*	*0.06–0.09*	*52*	*10*	*0.05*	*0.04–0.07*	*48*	*10*	*0.05*	*0.03–0.06*	*51*	*10*	*0.05*	*0.04–0.06*
Non-Malignant	*661*	*132*	*0.16*	*0.15–0.17*	*125*	*25*	*0.13*	*0.10–0.15*	*135*	*27*	*0.13*	*0.11–0.16*	*189*	*38*	*0.18*	*0.16–0.21*	*212*	*42*	*0.20*	*0.17–0.23*
All Other	36	7	0.01	0.01-0.01	16	3	0.02	0.01–0.03	--	--	--	--	--	--	--	--	--	--	--	--
TOTAL[d]	**24,931**	**4,986**	**6.06**	**5.98–6.13**	**6,194**	**1,239**	**6.22**	**6.07–6.38**	**5,517**	**1,103**	**5.38**	**5.24–5.53**	**5,829**	**1,166**	**5.65**	**5.50–5.79**	**7,391**	**1,478**	**6.98**	**6.82–7.14**
Malignant	***14,421***	***2,884***	***3.51***	***3.45–3.57***	***4,580***	***916***	***4.60***	***4.47–4.74***	***3,807***	***761***	***3.72***	***3.60–3.84***	***3,310***	***662***	***3.21***	***3.10–3.32***	***2,724***	***545***	***2.57***	***2.48–2.67***
Non-Malignant	***10,510***	***2,102***	***2.54***	***2.50–2.59***	***1,614***	***323***	***1.62***	***1.54–1.70***	***1,710***	***342***	***1.67***	***1.59–1.75***	***2,519***	***504***	***2.44***	***2.35–2.54***	***4,667***	***933***	***4.41***	***4.28–4.54***

a. Annual average cases are calculated by dividing the five-year total by five.
b. Rates are per 100,000 and are age-adjusted to the 2000 US standard population.
c. ICD-O-3 histology and behavior codes: 8963/3, 9364/3, 9480/3, 9490/0, 9490/3, 9500/3, 9501/3, and 9502/3.
d. Refers to all brain tumors including histologies not presented in this table.
-- Counts and rates are not presented when fewer than 16 cases were reported for the specific category, or where the inclusion of the count and rate would allow for back-calculation of suppressed values. The suppressed cases are included in the counts and rates for Totals.
Abbreviations: CBTRUS, Central Brain Tumor Registry of the United States; NPCR, National Program of Cancer Registries; SEER, Surveillance, Epidemiology, and End Results Program; CI, Confidence Interval; NOS, Not otherwise specified

Table 7 Average annual age-specific incidence rates[a] with 95% confidence intervals for all brain and other central nervous system tumors by major histology grouping, histology, and age at diagnosis, CBTRUS Statistical Report: U.S. Cancer Statistics – NPCR and SEER, 2012–2016

Histology	Age At Diagnosis													
	20–34 Years		35–44 Years		45–54 Years		55–64 Years		65–74 Years		75–84 Years		85+ Years	
	Rate	95% CI	Rate	95% CI	Rate	95% CI	Rate	95% CI	Rate	95% CI	Rate	95% CI	Rate	95% CI
Tumors of Neuroepithelial Tissue	**3.34**	**3.28–3.40**	**4.44**	**4.35–4.54**	**6.67**	**6.56–6.78**	**11.32**	**11.17–11.47**	**16.88**	**16.65–17.10**	**19.34**	**19.01–19.67**	**12.21**	**11.82–12.60**
Pilocytic Astrocytoma	0.21	0.20–0.23	0.12	0.11–0.14	0.09	0.08–0.11	0.07	0.06–0.08	0.06	0.05–0.08	0.07	0.05–0.09	--	--
Diffuse Astrocytoma	0.47	0.44–0.49	0.49	0.46–0.52	0.47	0.44–0.50	0.59	0.56–0.63	0.80	0.75–0.85	0.89	0.82–0.96	0.49	0.42–0.58
Anaplastic Astrocytoma	0.37	0.35–0.39	0.47	0.44–0.50	0.50	0.47–0.53	0.67	0.64–0.71	0.93	0.88–0.99	0.94	0.87–1.02	0.42	0.35–0.50
Unique Astrocytoma Variants	0.07	0.06–0.08	0.04	0.04–0.06	0.03	0.03–0.04	0.04	0.03–0.05	0.07	0.05–0.08	0.08	0.06–0.11	0.07	0.05–0.11
Malignant	*0.05*	*0.04–0.06*	*0.04*	*0.03–0.05*	--	--	--	--	--	--	--	--	--	--
Non-Malignant	*0.02*	*0.01–0.02*	*0.01*	*0.01-0.01*	--	--	--	--	--	--	--	--	--	--
Glioblastoma	0.46	0.44–0.49	1.24	1.19–1.29	3.57	3.49–3.65	8.07	7.94–8.19	12.98	12.78–13.17	15.29	14.99–15.58	9.06	8.73–9.41
Oligodendroglioma	0.28	0.26–0.30	0.42	0.39–0.44	0.37	0.34–0.40	0.28	0.25–0.30	0.19	0.17–0.22	0.13	0.11–0.16	0.08	0.05–0.12
Anaplastic Oligodendroglioma	0.09	0.08–0.10	0.18	0.16–0.20	0.21	0.19–0.23	0.19	0.17–0.21	0.16	0.14–0.19	0.12	0.09–0.15	--	--
Oligoastrocytic Tumors	0.19	0.18–0.21	0.24	0.21–0.26	0.17	0.15–0.19	0.15	0.13–0.17	0.14	0.12–0.16	0.09	0.06–0.11	--	--
Ependymal Tumors	0.36	0.34–0.38	0.52	0.49–0.56	0.57	0.54–0.60	0.55	0.52–0.59	0.60	0.56–0.64	0.42	0.37–0.47	0.13	0.10–0.18
Malignant	*0.19*	*0.17–0.20*	*0.28*	*0.26–0.30*	*0.29*	*0.27–0.31*	*0.30*	*0.27–0.32*	*0.32*	*0.29–0.35*	*0.25*	*0.22–0.29*	*0.06*	*0.04–0.10*
Non-Malignant	*0.17*	*0.16–0.19*	*0.25*	*0.22–0.27*	*0.28*	*0.26–0.31*	*0.25*	*0.23–0.28*	*0.28*	*0.25–0.31*	*0.16*	*0.14–0.20*	*0.07*	*0.04–0.11*
Glioma Malignant, NOS	0.27	0.26–0.29	0.26	0.24–0.29	0.31	0.29–0.34	0.36	0.34–0.39	0.59	0.55–0.64	1.04	0.96–1.12	1.74	1.60–1.90
Choroid Plexus Tumors	0.04	0.03–0.04	0.04	0.03–0.05	0.03	0.02–0.04	0.03	0.02–0.04	0.04	0.03–0.05	0.03	0.02–0.05	--	--
Malignant	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Non-Malignant	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Other Neuroepithelial Tumors	0.01	0.00–0.01	0.01	0.01-0.01	--	--	--	--	--	--	--	--	--	--
Malignant	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Non-Malignant	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Neuronal and Mixed Neuronal Glial Tumors	0.31	0.29–0.33	0.26	0.24–0.28	0.24	0.22–0.26	0.22	0.20–0.24	0.23	0.20–0.25	0.18	0.15–0.21	0.08	0.06–0.12
Malignant	*0.03*	*0.03–0.04*	*0.07*	*0.05–0.08*	*0.08*	*0.07–0.09*	*0.10*	*0.08–0.11*	*0.12*	*0.10–0.14*	*0.11*	*0.08–0.13*	--	--
Non-Malignant	*0.28*	*0.26–0.30*	*0.19*	*0.18–0.21*	*0.16*	*0.14–0.18*	*0.12*	*0.10–0.13*	*0.10*	*0.09–0.12*	*0.07*	*0.05–0.09*	--	--
Tumors of the Pineal Region	0.05	0.05–0.06	0.06	0.05–0.07	0.05	0.04–0.06	0.04	0.03–0.05	0.05	0.04–0.06	0.03	0.02–0.05	--	--
Malignant	*0.03*	*0.02–0.03*	*0.02*	*0.02–0.03*	*0.03*	*0.02–0.03*	*0.02*	*0.01–0.03*	*0.02*	*0.01–0.03*	--	--	--	--
Non-Malignant	*0.03*	*0.02–0.03*	*0.03*	*0.03–0.04*	*0.03*	*0.02–0.03*	*0.02*	*0.02–0.03*	*0.03*	*0.02–0.04*	--	--	--	--
Embryonal Tumors	0.15	0.14–0.17	0.09	0.08–0.11	0.05	0.04–0.06	0.05	0.04–0.06	0.04	0.03–0.05	0.04	0.02–0.05	--	--
Tumors of Cranial and Spinal Nerves	**0.94**	**0.90–0.97**	**2.11**	**2.05–2.17**	**3.27**	**3.20–3.35**	**4.50**	**4.40–4.59**	**5.23**	**5.11–5.36**	**4.01**	**3.86–4.16**	**1.75**	**1.60–1.90**
Nerve Sheath Tumors	0.94	0.90–0.97	2.11	2.04–2.17	3.27	3.19–3.35	4.49	4.40–4.59	5.23	5.10–5.35	4.00	3.85–4.16	1.75	1.60–1.90
Malignant	*0.01*	*0.01-0.01*	*0.02*	*0.01–0.02*	*0.02*	*0.01–0.03*	*0.02*	*0.01–0.03*	*0.03*	*0.02–0.05*	*0.03*	*0.02–0.05*	--	--
Non-Malignant	*0.93*	*0.89–0.96*	*2.09*	*2.03–2.15*	*3.25*	*3.17–3.33*	*4.47*	*4.38–4.57*	*5.19*	*5.07–5.32*	*3.97*	*3.83–4.13*	--	--
Other Tumors of Cranial and Spinal Nerves	--	--	--	--	--	--	--	--	--	--	--	--	--	--

Table 7 Continued

Histology	Age At Diagnosis													
	20–34 Years		35–44 Years		45–54 Years		55–64 Years		65–74 Years		75–84 Years		85+ Years	
	Rate	95% CI	Rate	95% CI	Rate	95% CI	Rate	95% CI	Rate	95% CI	Rate	95% CI	Rate	95% CI
Tumors of Meninges	**1.69**	**1.64–1.73**	**5.71**	**5.61–5.82**	**10.60**	**10.47–10.74**	**16.52**	**16.34–16.70**	**28.62**	**28.32–28.91**	**42.23**	**41.74–42.72**	**53.52**	**52.70–54.34**
Meningioma	1.44	1.40–1.48	5.39	5.29–5.50	10.22	10.09–10.36	16.09	15.92–16.27	28.16	27.87–28.46	41.80	41.31–42.28	53.37	52.56–54.20
Malignant	*0.02*	*0.01–0.02*	*0.05*	*0.04–0.06*	*0.11*	*0.09–0.12*	*0.20*	*0.18–0.22*	*0.35*	*0.32–0.38*	*0.45*	*0.40–0.50*	*0.57*	*0.49–0.66*
Non-Malignant	*1.42*	*1.38–1.46*	*5.34*	*5.24–5.45*	*10.12*	*9.98–10.25*	*15.89*	*15.72–16.07*	*27.81*	*27.52–28.10*	*41.35*	*40.87–41.83*	*52.81*	*52.00–53.62*
Mesenchymal Tumors	--	--	--	--	0.12	0.11–0.14	0.12	0.11–0.14	--	--	--	--	--	--
Primary Melanocytic Lesions	--	--	--	--	0.01	0.00–0.01	0.02	0.01–0.02	--	--	--	--	--	--
Other Neoplasms Related to the Meninges	0.18	0.17–0.20	0.23	0.21–0.26	0.25	0.23–0.27	0.29	0.27–0.31	0.30	0.27–0.33	0.27	0.23–0.31	0.08	0.05–0.12
Lymphomas and Hematopoietic Neoplasms	**0.10**	**0.09–0.11**	**0.23**	**0.21–0.25**	**0.40**	**0.38–0.43**	**0.87**	**0.83–0.91**	**1.81**	**1.73–1.88**	**2.41**	**2.30–2.53**	**1.18**	**1.06–1.31**
Lymphoma	0.09	0.08–0.10	0.21	0.19–0.23	0.39	0.36–0.42	0.85	0.81–0.89	1.78	1.71–1.85	2.39	2.28–2.51	1.16	1.05–1.29
Other hematopoietic Neoplasms	0.01	0.01-0.01	0.01	0.01–0.02	0.01	0.01–0.02	0.01	0.01–0.02	0.03	0.02–0.04	--	--	--	--
Germ Cell Tumors and Cysts	**0.11**	**0.10–0.12**	**0.04**	**0.03–0.05**	**0.03**	**0.02–0.04**	**0.02**	**0.02–0.03**	**0.02**	**0.02–0.03**	**--**	**--**	**--**	**--**
Germ cell tumors, cysts, and heterotopias	0.11	0.10–0.12	0.04	0.03–0.05	0.03	0.02–0.04	0.02	0.02–0.03	0.02	0.02–0.03	--	--	--	--
Malignant	*0.08*	*0.07–0.09*	*0.01*	*0.01-0.01*	--	--	--	--	--	--	--	--	--	--
Non-Malignant	*0.03*	*0.02–0.03*	*0.03*	*0.02–0.04*	*0.03*	*0.02–0.03*	*0.02*	*0.01–0.03*	*0.02*	*0.02–0.03*	--	--	--	--
Tumors of Sellar Region	**3.96**	**3.89–4.03**	**5.45**	**5.35–5.55**	**5.56**	**5.46–5.66**	**6.39**	**6.28–6.51**	**8.22**	**8.06–8.38**	**8.41**	**8.19–8.63**	**5.03**	**4.78–5.29**
Tumors of the Pituitary	3.84	3.77–3.91	5.28	5.18–5.38	5.34	5.24–5.44	6.15	6.04–6.26	7.95	7.80–8.11	8.18	7.97–8.40	4.95	4.70–5.21
Malignant	--	--	*0.01*	*0.01–0.02*	*0.01*	*0.01–0.02*	*0.02*	*0.01–0.03*	*0.02*	*0.01–0.03*	--	--	--	--
Non-Malignant	--	--	*5.27*	*5.17–5.37*	*5.33*	*5.23–5.43*	*6.13*	*6.02–6.24*	*7.93*	*7.78–8.09*	--	--	--	--
Craniopharyngioma	0.12	0.11–0.13	0.17	0.15–0.18	0.22	0.20–0.24	0.24	0.22–0.26	0.27	0.24–0.30	0.22	0.19–0.26	0.08	0.05–0.12
Unclassified Tumors	**0.59**	**0.57–0.62**	**0.86**	**0.82–0.90**	**1.10**	**1.05–1.14**	**1.51**	**1.45–1.56**	**2.48**	**2.39–2.57**	**4.88**	**4.72–5.05**	**10.79**	**10.42–11.16**
Hemangioma	0.30	0.28–0.32	0.42	0.39–0.45	0.47	0.45–0.50	0.53	0.50–0.56	0.65	0.60–0.69	0.65	0.59–0.72	0.54	0.46–0.63
Neoplasm Unspecified	0.30	0.28–0.31	0.43	0.40–0.46	0.62	0.59–0.65	0.97	0.93–1.02	1.80	1.73–1.88	4.19	4.04–4.35	10.18	9.83–10.55
Malignant	*0.07*	*0.06–0.07*	*0.11*	*0.10–0.13*	*0.21*	*0.19–0.23*	*0.43*	*0.41–0.46*	*0.88*	*0.83–0.94*	*2.37*	*2.26–2.49*	*5.99*	*5.72–6.27*
Non-Malignant	*0.23*	*0.21–0.25*	*0.32*	*0.30–0.35*	*0.41*	*0.38–0.44*	*0.54*	*0.51–0.57*	*0.92*	*0.86–0.97*	*1.82*	*1.72–1.93*	*4.19*	*3.97–4.43*
All Other	--	--	--	--	--	--	--	--	0.03	0.02–0.04	0.04	0.02–0.05	0.07	0.04–0.10
TOTAL[b]	**10.72**	**10.61–10.84**	**18.83**	**18.65–19.02**	**27.63**	**27.41–27.86**	**41.13**	**40.85–41.41**	**63.25**	**62.82–63.69**	**81.29**	**80.62–81.97**	**84.48**	**83.46–85.52**
Malignant	***3.12***	***3.06–3.18***	***4.39***	***4.30–4.48***	***6.98***	***6.87–7.09***	***12.51***	***12.36–12.67***	***19.61***	***19.36–19.85***	***24.43***	***24.06–24.80***	***19.89***	***19.39–20.39***
Non-Malignant	***7.61***	***7.51–7.70***	***14.44***	***14.28–14.61***	***20.65***	***20.46–20.85***	***28.62***	***28.38–28.85***	***43.65***	***43.29–44.01***	***56.87***	***56.30–57.43***	***64.59***	***63.70–65.50***

a. Rates are per 100,000 and age-adjusted to the 2000 US standard population.
b. Refers to all brain tumors including histologies not presented in this table.
-- Counts and rates are not presented when fewer than 16 cases were reported for the specific category, or where the inclusion of the count and rate would allow for back-calculation of suppressed values. The suppressed cases are included in the counts and rates for Totals.
Abbreviations: CBTRUS, Central Brain Tumor Registry of the United States; NPCR, National Program of Cancer Registries; SEER, Surveillance, Epidemiology, and End Results Program; CI, Confidence Interval; NOS, Not otherwise specified

Table 8 Five-year total, annual average total[a], and average annual age-adjusted incidence rates[b] with 95% confidence intervals of brain and other central nervous system tumors by site and sex, CBTRUS Statistical Report: U.S. Cancer Statistics – NPCR and SEER, 2012–2016

Site (ICD-O-3 Code)[c]	Total					Male						Female					
	5-Year Total	Annual Average	% of All Tumors	Rate	95% CI	5-Year Total	Annual Average	% Malignant	% Non-Malignant	Rate	95% CI	5-Year Total	Annual Average	% Malignant	% Non-Malignant	Rate	95% CI
Frontal, temporal, parietal, and occipital lobes of the brain (C71.1-C71.4)	74,346	14,869	18.3%	4.24	4.21–4.27	41,349	8,270	91.4%	8.6%	4.99	4.94–5.04	32,997	6,599	88.2%	11.8%	3.58	3.54–3.62
Frontal lobe (C71.1)	*32,419*	*6,484*	*8.0%*	*1.87*	*1.85–1.89*	*17,232*	*3,446*	92.1%	7.9%	*2.10*	*2.06–2.13*	*15,187*	*3,037*	89.4%	10.6%	*1.67*	*1.64–1.70*
Temporal lobe (C71.2)	*24,129*	*4,826*	*5.9%*	*1.37*	*1.35–1.38*	*14,353*	*2,871*	90.6%	9.4%	*1.72*	*1.69–1.75*	*9,776*	*1,955*	86.9%	13.1%	*1.06*	*1.04–1.08*
Parietal lobe (C71.3)	*13,987*	*2,797*	*3.4%*	*0.78*	*0.77–0.80*	*7,653*	*1,531*	93.0%	7.0%	*0.92*	*0.90–0.94*	*6,334*	*1,267*	89.2%	10.8%	*0.67*	*0.65–0.69*
Occipital lobe (C71.4)	*3,811*	*762*	*0.9%*	*0.22*	*0.21–0.22*	*2,111*	*422*	86.0%	14.0%	*0.26*	*0.24–0.27*	*1,700*	*340*	82.5%	17.5%	*0.18*	*0.17–0.19*
Cerebrum (C71.0)	6,985	1,397	1.7%	0.41	0.40–0.42	3,783	757	82.9%	17.1%	0.46	0.45–0.48	3,202	640	79.8%	20.2%	0.36	0.35–0.38
Ventricle (C71.5)	4,071	814	1.0%	0.25	0.25–0.26	2,167	433	42.4%	57.6%	0.27	0.26–0.29	1,904	381	40.3%	59.7%	0.24	0.23–0.25
Cerebellum (C71.6)	8,838	1,768	2.2%	0.56	0.55–0.57	4,685	937	62.9%	37.1%	0.60	0.59–0.62	4,153	831	55.3%	44.7%	0.52	0.50–0.53
Brain stem (C71.7)	6,171	1,234	1.5%	0.40	0.39–0.41	3,363	673	76.1%	23.9%	0.43	0.42–0.45	2,808	562	77.2%	22.8%	0.36	0.35–0.38
Other brain (C71.8-C71.9)	33,741	6,748	8.3%	1.93	1.91–1.95	17,694	3,539	83.3%	16.7%	2.18	2.15–2.21	16,047	3,209	78.5%	21.5%	1.72	1.69–1.74
Spinal cord and cauda equina (C72.0-C72.1)	12,775	2,555	3.1%	0.77	0.75–0.78	6,687	1,337	28.3%	71.7%	0.83	0.81–0.85	6,088	1,218	26.7%	73.3%	0.71	0.69–0.73
Cranial nerves (C72.2-C72.5)	28,534	5,707	7.0%	1.64	1.62–1.66	13,398	2,680	6.0%	94.0%	1.60	1.57–1.63	15,136	3,027	5.4%	94.6%	1.68	1.65–1.70
Other nervous system (C72.8-C72.9)	2,510	502	0.6%	0.15	0.14–0.15	1,269	254	55.8%	44.2%	0.16	0.15–0.17	1,241	248	54.2%	45.8%	0.14	0.13–0.15
Meninges (cerebral and spinal) (C70.0-C70.9)	153,078	30,616	37.7%	8.58	8.53–8.62	41,300	8,260	2.3%	97.7%	5.11	5.06–5.16	111,778	22,356	1.1%	98.9%	11.64	11.57–11.71
Pituitary and craniopharyngeal duct (C75.1-C75.2)	72,162	14,432	17.8%	4.34	4.31–4.37	32,701	6,540	0.8%	99.2%	3.99	3.95–4.04	39,461	7,892	0.5%	99.5%	4.77	4.72–4.82
Pineal (C75.3)	1,762	352	0.4%	0.11	0.11–0.12	1,018	204	74.2%	25.8%	0.13	0.12–0.14	744	149	42.3%	57.7%	0.09	0.09–0.10
Olfactory tumors of the nasal cavity (C30.0[d])	767	153	0.2%	0.04	0.04–0.05	454	91	100.0%	0.0%	0.05	0.05–0.06	313	63	100.0%	0.0%	0.04	0.03–0.04
TOTAL	**405,740**	**81,148**	**100.0%**	**23.41**	**23.34–23.49**	**169,868**	**33,974**	**40.0%**	**60.0%**	**20.82**	**20.72–20.92**	**235,872**	**47,174**	**23.2%**	**76.8%**	**25.84**	**25.73–25.95**

a. Annual average cases are calculated by dividing the five-year total by five.
b. Rates are per 100,000 and are age-adjusted to the 2000 US standard population.
c. The sites referred to in this table are loosely based on the categories and site code defined in the SEER site/histology validation list.
d. ICD-O-3 histology codes 9522–9523 only.
- Counts and rates are not presented when fewer than 16 cases were reported for the specific category, or where the inclusion of the count and rate would allow for back-calculation of suppressed values. The suppressed cases are included in the counts and rates for Totals.
Abbreviations: CBTRUS, Central Brain Tumor Registry of the United States; NPCR, National Program of Cancer Registries; SEER, Surveillance, Epidemiology, and End Results Program; CI, Confidence Interval; NOS, Not otherwise specified

Table 9 Characteristics of all brain and other central nervous system tumors by central cancer registry and behavior, CBTRUS Statistical Report: U.S. Cancer Statistics – NPCR and SEER, 2012–2016

State	Total				Malignant				Non-Malignant				Average Annual Population[a]
	5-Year Total	Annual Average	Histologically Confirmed (%)	Radiographically Confirmed (%)	5-Year Total	% Malignant	Histologically Confirmed (%)	Radiographically Confirmed (%)	5-Year Total	% Non-Malignant	Histologically Confirmed (%)	Radiographically Confirmed (%)	
Alabama	4,817	963	65.2%	29.5%	1868	38.8%	81.7%	6.91%	2949	61.2%	54.7%	43.8%	4,838,609
Alaska	855	171	48.8%	47.7%	246	28.8%	82.5%	11.38%	609	71.2%	35.1%	62.4%	736,769
Arizona	7,570	1,514	62.7%	31.9%	2,477	32.7%	82.8%	7.95%	5,093	67.3%	52.9%	43.5%	6,715,535
Arkansas	3,451	690	54.8%	40.0%	1,213	35.1%	79.6%	11.29%	2,238	64.8%	41.4%	55.6%	2,966,929
California	43,842	8,768	59.9%	35.7%	13,179	30.1%	85.9%	8.60%	30,663	69.9%	48.7%	47.4%	38,679,317
Colorado	7,454	1,491	49.1%	47.8%	1,919	25.7%	81.0%	12.92%	5,535	74.3%	38.1%	59.9%	5,352,349
Connecticut	4,461	892	67.7%	30.1%	1,526	34.2%	88.4%	9.04%	2,935	65.8%	57.0%	41.1%	3,596,382
Delaware	1,050	210	67.9%	28.9%	372	35.4%	82.3%	12.37%	678	64.6%	60.0%	37.9%	934,718
District of Columbia	716	143	63.1%	34.6%	196	27.4%	90.3%	4.59%	520	72.6%	52.9%	46.0%	660,723
Florida	29,531	5,906	53.1%	43.4%	8,333	28.2%	84.7%	10.40%	21,198	71.8%	40.7%	56.4%	19,949,831
Georgia	13,037	2,607	50.7%	45.2%	3,427	26.3%	84.1%	11.50%	9,610	73.7%	38.7%	57.2%	10,097,989
Hawaii	1,517	303	53.0%	39.1%	384	25.3%	85.2%	8.33%	1,133	74.7%	42.1%	49.5%	1,414,705
Idaho	1,943	389	63.7%	33.1%	694	35.7%	84.4%	11.53%	1,249	64.3%	52.1%	45.2%	1,632,920
Illinois	16,780	3,356	57.0%	40.9%	4,786	28.5%	87.5%	8.67%	11,994	71.5%	44.8%	53.7%	12,869,822
Indiana	7,902	1,580	53.2%	43.5%	2,557	32.4%	84.0%	11.73%	5,345	67.6%	38.4%	58.7%	6,588,187
Iowa	4,408	882	56.8%	40.7%	1,354	30.7%	84.5%	11.08%	3,054	69.3%	44.5%	53.8%	3,103,833
Kansas	3,686	737	53.4%	43.1%	1,149	31.2%	84.9%	10.36%	2,537	68.8%	39.2%	57.9%	2,898,258
Kentucky	6,875	1,375	48.5%	46.6%	1,953	28.4%	78.9%	12.65%	4,922	71.6%	36.4%	60.1%	4,410,276
Louisiana	5,953	1,191	57.5%	37.4%	1,642	27.6%	85.1%	10.17%	4,311	72.4%	47.0%	47.8%	4,647,128
Maine	1,565	313	65.1%	31.6%	670	42.8%	84.0%	10.75%	895	57.2%	50.9%	47.3%	1,328,600
Maryland	6,862	1,372	64.8%	31.0%	2,161	31.5%	86.8%	6.71%	4,701	68.5%	54.7%	42.1%	5,963,978
Massachusetts	6,712	1,342	70.8%	25.7%	2,595	38.7%	87.6%	7.59%	4,117	61.3%	60.2%	37.1%	6,749,283
Michigan	11,686	2,337	59.6%	35.9%	3,921	33.5%	84.0%	8.67%	7,765	66.5%	47.3%	49.6%	9,910,424
Minnesota	6,273	1,255	72.8%	23.5%	2,312	36.9%	88.3%	7.70%	3,961	63.1%	63.7%	32.7%	5,450,941
Mississippi	3,445	689	58.8%	37.7%	1,066	30.9%	85.4%	11.16%	2,379	69.1%	47.0%	49.6%	2,985,995
Missouri	8,021	1,604	54.6%	41.5%	2,463	30.7%	86.3%	8.08%	5,558	69.3%	40.5%	56.3%	6,057,248
Montana	1,402	280	54.3%	41.8%	479	34.2%	82.3%	12.73%	923	65.8%	39.8%	56.9%	1,020,469
Nebraska	2,055	411	59.4%	37.2%	749	36.5%	84.6%	8.81%	1,306	63.5%	44.9%	53.4%	1,880,873
Nevada	2,776	555	58.3%	36.0%	1,010	36.4%	82.9%	6.73%	1,766	63.6%	44.3%	52.7%	2,838,600

Table 9 Continued

State	Total				Malignant				Non-Malignant				Average Annual Population[a]
	5-Year Total	Annual Average	Histologically Confirmed (%)	Radiographically Confirmed (%)	5-Year Total	% Malignant	Histologically Confirmed (%)	Radiographically Confirmed (%)	5-Year Total	% Non-Malignant	Histologically Confirmed (%)	Radiographically Confirmed (%)	
New Hampshire	1,671	334	64.6%	32.9%	598	35.8%	89.6%	6.19%	1,073	64.2%	50.7%	47.7%	1,327,476
New Jersey	12,551	2,510	56.5%	38.7%	3,724	29.7%	87.1%	9.10%	8,827	70.3%	43.6%	51.2%	8,935,451
New Mexico	2,127	425	65.0%	28.7%	681	32.0%	86.8%	7.05%	1,446	68.0%	54.8%	38.9%	2,083,931
New York	29,691	5,938	52.4%	44.4%	7,854	26.4%	84.1%	11.33%	21,837	73.5%	41.0%	56.3%	19,753,427
North Carolina	12,947	2,589	56.0%	40.4%	3,771	29.1%	84.3%	10.26%	9,176	70.9%	44.4%	52.8%	9,948,946
North Dakota	796	159	53.6%	43.7%	273	34.3%	85.0%	10.99%	523	65.7%	37.3%	60.8%	734,671
Ohio	13,537	2,707	64.9%	30.8%	4,873	36.0%	85.3%	7.74%	8,664	64.0%	53.5%	43.7%	11,587,427
Oklahoma	4,595	919	53.7%	42.8%	1,490	32.4%	81.6%	11.07%	3,105	67.6%	40.3%	58.1%	3,873,141
Oregon	4,592	918	66.7%	28.7%	1,744	38.0%	83.1%	7.34%	2,848	62.0%	56.7%	41.8%	3,975,357
Pennsylvania	19,515	3,903	51.3%	44.5%	5,785	29.6%	82.0%	10.49%	13,730	70.4%	38.4%	58.9%	12,783,007
Rhode Island	1,144	229	67.7%	29.9%	425	37.1%	89.6%	7.53%	719	62.9%	54.8%	43.1%	1,054,762
South Carolina	6,320	1,264	51.9%	42.5%	1,861	29.4%	83.2%	9.94%	4,459	70.5%	38.9%	56.0%	4,832,375
South Dakota	1,013	203	49.7%	47.3%	342	33.8%	80.4%	15.50%	671	66.2%	34.0%	63.5%	848,024
Tennessee	8,866	1,773	53.0%	44.5%	2,479	28.0%	86.5%	9.72%	6,387	72.0%	40.0%	58.0%	6,544,313
Texas	32,412	6,482	50.7%	42.9%	9,267	28.6%	80.3%	13.11%	23,145	71.4%	38.9%	54.8%	26,974,357
Utah	4,614	923	49.4%	49.4%	964	20.9%	85.3%	12.86%	3,650	79.1%	40.0%	59.0%	2,944,418
Vermont	877	175	56.8%	40.6%	249	28.4%	90.4%	5.22%	628	71.6%	43.5%	54.6%	625,025
Virginia	8,537	1,707	64.5%	31.0%	2,963	34.7%	84.8%	6.41%	5,574	65.3%	53.8%	44.0%	8,309,679
Washington	11,704	2,341	47.4%	48.7%	3,014	25.8%	82.1%	11.51%	8,690	74.2%	35.3%	61.5%	7,066,998
West Virginia	2,387	477	57.6%	39.5%	824	34.5%	88.2%	8.98%	1,563	65.5%	41.5%	55.7%	1,844,744
Wisconsin	8,525	1,705	51.2%	45.4%	2,457	28.8%	84.0%	11.52%	6,068	71.2%	37.9%	59.1%	5,748,336
Wyoming	674	135	65.1%	33.7%	230	34.1%	87.8%	10.43%	444	65.9%	53.4%	45.7%	582,659
TOTAL	**405,740**	**81,148**	**56.3%**	**39.7%**	**122,569**	**30.2%**	**84.4%**	**9.85%**	**283,171**	**69.8%**	**44.1%**	**52.6%**	**318,659,215**

a. Population estimates were obtained from the United States Bureau of the Census available on the SEER program website.
- Counts and rates are not presented when fewer than 16 cases were reported for the specific category, or where the inclusion of the count and rate would allow for back-calculation of suppressed values. The suppressed cases are included in the counts and rates for Totals.
Abbreviations: CBTRUS, Central Brain Tumor Registry of the United States; NPCR, National Program of Cancer Registries; SEER, Surveillance, Epidemiology, and End Results Program

Table 10 Average annual age-adjusted incidence rates[a] with 95% confidence intervals for all brain and other central nervous system tumors by age, behavior, and central cancer registry, CBTRUS Statistical Report: U.S. Cancer Statistics – NPCR and SEER, 2012–2016

State	0–19 Years						20+ Years						All Ages					
	Malignant		Non-Malignant		All Tumors		Malignant		Non-Malignant		All Tumors		Malignant		Non-Malignant		All Tumors	
	Rate	95% CI	Rate	95% CI	Rate	95% CI	Rate	95% CI	Rate	95% CI	Rate	95% CI	Rate	95% CI	Rate	95% CI	Rate	95% CI
Alabama	3.77	3.30–4.29	1.33	1.06–1.65	5.11	4.56–5.70	8.24	7.84–8.66	14.73	14.18–15.30	22.98	22.29–23.68	6.96	6.64–7.29	10.89	10.49–11.30	17.85	17.34–18.38
Alaska	2.61	1.72–3.79	3.93	2.79–5.37	6.54	5.05–8.32	8.68	7.49–10.00	23.03	21.05–25.14	31.71	29.38–34.17	6.94	6.05–7.92	17.55	16.09–19.10	24.49	22.77–26.30
Arizona	3.03	2.68–3.41	2.43	2.12–2.77	5.46	4.99–5.96	8.11	7.77–8.46	18.44	17.92–18.98	26.55	25.92–27.19	6.65	6.39–6.93	13.85	13.46–14.24	20.50	20.03–20.98
Arkansas	3.46	2.90–4.09	2.39	1.94–2.93	5.85	5.12–6.66	8.88	8.34–9.44	18.09	17.31–18.89	26.97	26.02–27.94	7.32	6.91–7.76	13.59	13.02–14.18	20.91	20.20–21.64
California	3.07	2.92–3.23	2.24	2.12–2.38	5.32	5.12–5.52	8.01	7.86–8.16	20.59	20.35–20.83	28.60	28.32–28.88	6.59	6.48–6.71	15.33	15.15–15.50	21.92	21.71–22.13
Colorado	3.27	2.86–3.72	2.14	1.81–2.52	5.41	4.88–5.99	8.38	7.98–8.80	27.30	26.56–28.06	35.69	34.84–36.55	6.92	6.60–7.24	20.09	19.55–20.64	27.00	26.38–27.64
Connecticut	3.57	3.02–4.18	2.67	2.22–3.20	6.24	5.53–7.02	9.10	8.61–9.61	19.19	18.47–19.94	28.30	27.42–29.20	7.52	7.13–7.91	14.45	13.92–15.01	21.97	21.31–22.65
Delaware	3.84	2.79–5.15	2.92	2.03–4.09	6.76	5.35–8.44	8.21	7.32–9.18	16.88	15.56–18.29	25.09	23.49–26.78	6.95	6.25–7.72	12.88	11.90–13.92	19.83	18.61–21.11
District of Columbia	4.25	2.85–6.10	2.41	1.36–3.94	6.67	4.85–8.93	6.95	5.91–8.12	21.59	19.69–23.61	28.53	26.36–30.84	6.18	5.32–7.13	16.09	14.69–17.57	22.26	20.61–24.01
Florida	3.54	3.30–3.80	3.06	2.84–3.29	6.60	6.27–6.95	8.37	8.17–8.56	23.12	22.79–23.45	31.49	31.11–31.87	6.98	6.83–7.14	17.37	17.12–17.61	24.35	24.06–24.64
Georgia	3.49	3.18–3.81	2.68	2.41–2.96	6.16	5.76–6.59	7.97	7.68–8.27	25.30	24.78–25.84	33.28	32.68–33.88	6.68	6.46–6.92	18.81	18.43–19.20	25.50	25.05–25.95
Hawaii	1.72	1.15–2.46	1.89	1.28–2.68	3.61	2.75–4.64	5.94	5.32–6.62	18.78	17.65–19.97	24.73	23.43–26.08	4.73	4.25–5.25	13.94	13.11–14.81	18.67	17.71–19.67
Idaho	3.69	2.96–4.55	1.96	1.43–2.61	5.65	4.73–6.69	9.73	8.95–10.56	19.61	18.49–20.78	29.34	27.97–30.76	8.00	7.40–8.63	14.55	13.73–15.39	22.54	21.53–23.59
Illinois	3.35	3.08–3.64	2.54	2.31–2.79	5.89	5.53–6.27	8.34	8.09–8.60	23.28	22.85–23.72	31.62	31.12–32.13	6.91	6.71–7.11	17.33	17.02–17.65	24.24	23.87–24.62
Indiana	3.37	3.00–3.77	2.47	2.16–2.82	5.84	5.35–6.36	8.78	8.41–9.16	20.04	19.48–20.61	28.82	28.15–29.50	7.23	6.94–7.52	15.00	14.59–15.42	22.22	21.73–22.73
Iowa	3.59	3.04–4.22	3.66	3.10–4.29	7.25	6.45–8.12	9.39	8.85–9.96	23.26	22.40–24.16	32.66	31.63–33.71	7.73	7.31–8.17	17.64	17.00–18.30	25.37	24.60–26.15
Kansas	3.68	3.11–4.32	2.51	2.04–3.06	6.19	5.44–7.01	8.85	8.29–9.43	22.14	21.25–23.06	30.99	29.93–32.07	7.36	6.93–7.81	16.51	15.86–17.18	23.87	23.09–24.68
Kentucky	4.12	3.61–4.69	3.58	3.10–4.11	7.70	7.00–8.46	9.70	9.24–10.18	27.13	26.34–27.94	36.83	35.91–37.76	8.10	7.74–8.48	20.37	19.79–20.97	28.47	27.79–29.17
Louisiana	3.75	3.28–4.26	2.60	2.21–3.04	6.35	5.73–7.01	7.81	7.40–8.24	23.48	22.76–24.22	31.29	30.45–32.14	6.64	6.32–6.98	17.49	16.96–18.03	24.14	23.51–24.77
Maine	3.77	2.84–4.91	1.63	1.05–2.41	5.40	4.28–6.72	10.14	9.32–11.02	14.81	13.79–15.88	24.95	23.63–26.33	8.32	7.66–9.01	11.03	10.28–11.82	19.34	18.34–20.38
Maryland	3.26	2.86–3.69	1.62	1.35–1.94	4.88	4.39–5.41	8.17	7.80–8.55	19.55	18.97–20.13	27.72	27.03–28.42	6.76	6.47–7.06	14.40	13.99–14.83	21.17	20.66–21.69
Massachusetts	3.27	2.89–3.70	2.22	1.91–2.57	5.50	4.99–6.03	8.39	8.04–8.74	14.26	13.80–14.72	22.64	22.07–23.23	6.92	6.65–7.20	10.80	10.47–11.15	17.72	17.29–18.17
Michigan	3.50	3.18–3.85	1.88	1.65–2.13	5.38	4.98–5.81	8.51	8.22–8.80	18.73	18.29–19.17	27.23	26.71–27.77	7.07	6.84–7.30	13.90	13.58–14.22	20.97	20.58–21.36
Minnesota	3.95	3.50–4.43	2.42	2.07–2.81	6.36	5.79–6.98	9.44	9.02–9.87	17.62	17.05–18.21	27.07	26.36–27.79	7.86	7.54–8.20	13.26	12.84–13.69	21.13	20.59–21.67
Mississippi	2.72	2.24–3.28	2.42	1.97–2.95	5.15	4.47–5.89	8.18	7.66–8.73	19.96	19.13–20.81	28.14	27.15–29.15	6.61	6.22–7.03	14.93	14.32–15.55	21.54	20.81–22.29
Missouri	3.98	3.55–4.45	2.30	1.97–2.66	6.28	5.73–6.86	8.62	8.25–9.01	22.21	21.60–22.83	30.83	30.12–31.56	7.29	7.00–7.59	16.50	16.05–16.95	23.79	23.26–24.33
Montana	2.71	1.88–3.78	1.90	1.22–2.83	4.61	3.50–5.96	10.16	9.20–11.20	21.34	19.91–22.86	31.51	29.77–33.32	8.02	7.29–8.81	15.77	14.72–16.87	23.79	22.51–25.13
Nebraska	3.93	3.21–4.77	3.12	2.48–3.88	7.05	6.07–8.15	8.81	8.12–9.53	17.13	16.16–18.15	25.94	24.75–27.17	7.41	6.87–7.97	13.11	12.39–13.86	20.52	19.62–21.45
Nevada	3.03	2.49–3.65	1.45	1.08–1.90	4.48	3.82–5.22	7.96	7.43–8.51	15.60	14.85–16.38	23.56	22.64–24.50	6.54	6.14–6.97	11.54	11.00–12.11	18.08	17.40–18.79

Table 10 Continued

State	0–19 Years						20+ Years						All Ages					
	Malignant		Non-Malignant		All Tumors		Malignant		Non-Malignant		All Tumors		Malignant		Non-Malignant		All Tumors	
	Rate	95% CI	Rate	95% CI	Rate	95% CI	Rate	95% CI	Rate	95% CI	Rate	95% CI	Rate	95% CI	Rate	95% CI	Rate	95% CI
New Hampshire	4.63	3.60–5.86	2.01	1.38–2.84	6.64	5.41–8.07	9.12	8.33–9.96	18.60	17.44–19.82	27.72	26.31–29.19	7.83	7.19–8.52	13.84	12.99–14.73	21.67	20.60–22.79
New Jersey	3.70	3.35–4.07	2.92	2.62–3.26	6.62	6.15–7.12	9.14	8.83–9.47	23.69	23.18–24.21	32.83	32.23–33.44	7.58	7.33–7.83	17.73	17.36–18.11	25.31	24.86–25.77
New Mexico	2.44	1.89–3.09	1.69	1.24–2.24	4.12	3.40–4.95	7.28	6.70–7.90	17.10	16.19–18.05	24.38	23.29–25.50	5.89	5.44–6.36	12.68	12.02–13.37	18.57	17.77–19.40
New York	4.03	3.78–4.29	3.88	3.64–4.14	7.91	7.56–8.27	8.58	8.37–8.79	26.50	26.14–26.87	35.08	34.66–35.51	7.27	7.11–7.44	20.01	19.74–20.29	27.29	26.97–27.61
North Carolina	3.53	3.22–3.88	2.31	2.05–2.59	5.84	5.43–6.28	8.31	8.03–8.61	22.70	22.22–23.18	31.01	30.45–31.58	6.94	6.72–7.17	16.85	16.50–17.20	23.79	23.37–24.21
North Dakota	2.78	1.83–4.05	2.82	1.86–4.11	5.60	4.20–7.31	8.55	7.48–9.73	18.38	16.74–20.14	26.93	24.96–29.01	6.89	6.08–7.79	13.92	12.71–15.21	20.81	19.34–22.36
Ohio	4.10	3.78–4.44	2.61	2.36–2.88	6.71	6.30–7.14	8.89	8.62–9.17	17.68	17.29–18.08	26.58	26.10–27.06	7.52	7.30–7.74	13.36	13.07–13.65	20.88	20.52–21.24
Oklahoma	3.27	2.80–3.80	2.16	1.78–2.59	5.43	4.82–6.09	8.61	8.14–9.10	20.08	19.35–20.83	28.69	27.82–29.58	7.08	6.72–7.45	14.94	14.41–15.49	22.02	21.37–22.68
Oregon	3.92	3.38–4.52	2.79	2.34–3.30	6.71	5.99–7.48	9.37	8.90–9.86	16.74	16.10–17.41	26.12	25.32–26.94	7.81	7.43–8.20	12.74	12.26–13.23	20.55	19.94–21.17
Pennsylvania	4.15	3.83–4.49	2.44	2.20–2.69	6.59	6.19–7.01	9.34	9.08–9.61	24.72	24.29–25.16	34.06	33.55–34.57	7.85	7.64–8.06	18.33	18.01–18.65	26.18	25.80–26.56
Rhode Island	2.23	1.47–3.25	1.69	1.05–2.57	3.92	2.89–5.19	8.90	8.02–9.85	15.79	14.60–17.05	24.69	23.20–26.25	6.99	6.32–7.71	11.74	10.87–12.67	18.73	17.62–19.89
South Carolina	3.14	2.71–3.62	2.27	1.91–2.68	5.41	4.84–6.02	8.29	7.89–8.71	22.03	21.36–22.72	30.32	29.54–31.12	6.81	6.50–7.14	16.36	15.87–16.86	23.17	22.59–23.77
South Dakota	3.38	2.42–4.61	1.36	0.78–2.21	4.74	3.58–6.16	8.91	7.90–10.02	19.93	18.38–21.58	28.84	26.98–30.80	7.33	6.55–8.17	14.60	13.48–15.79	21.93	20.56–23.37
Tennessee	3.56	3.17–3.99	2.72	2.38–3.10	6.28	5.76–6.85	8.20	7.86–8.56	23.75	23.15–24.37	31.96	31.26–32.67	6.87	6.60–7.16	17.72	17.28–18.17	24.59	24.07–25.12
Texas	3.59	3.41–3.78	2.54	2.39–2.71	6.13	5.89–6.38	8.31	8.12–8.50	23.91	23.59–24.23	32.22	31.85–32.59	6.96	6.81–7.10	17.78	17.55–18.01	24.73	24.46–25.01
Utah	2.73	2.29–3.23	3.25	2.76–3.81	5.98	5.31–6.71	9.03	8.41–9.68	38.65	37.35–39.97	47.68	46.24–49.15	7.22	6.76–7.70	28.49	27.56–29.45	35.71	34.67–36.78
Vermont	--	--	3.66	2.42–5.33	5.50	3.92–7.52	8.83	7.69–10.08	22.68	20.81–24.67	31.50	29.31–33.82	6.82	5.96–7.78	17.22	15.84–18.70	24.05	22.40–25.78
Virginia	3.09	2.77–3.45	1.76	1.51–2.03	4.85	4.44–5.29	8.06	7.75–8.38	16.61	16.16–17.07	24.67	24.12–25.22	6.63	6.39–6.88	12.35	12.02–12.68	18.98	18.57–19.40
Washington	4.11	3.70–4.55	3.49	3.11–3.90	7.60	7.03–8.19	9.49	9.12–9.87	30.63	29.97–31.31	40.12	39.36–40.90	7.94	7.66–8.24	22.85	22.36–23.34	30.79	30.22–31.37
West Virginia	3.91	3.11–4.85	2.28	1.68–3.01	6.18	5.17–7.34	9.12	8.45–9.83	19.11	18.12–20.14	28.23	27.03–29.47	7.63	7.09–8.19	14.28	13.55–15.04	21.90	21.00–22.84
Wisconsin	3.70	3.27–4.18	2.68	2.32–3.08	6.39	5.82–6.99	9.23	8.84–9.64	25.36	24.70–26.04	34.59	33.82–35.38	7.65	7.34–7.96	18.85	18.37–19.35	26.50	25.92–27.09
Wyoming	2.45	1.47–3.82	--	--	3.65	2.43–5.28	9.13	7.90–10.51	19.50	17.65–21.48	28.63	26.39–31.01	7.22	6.28–8.25	14.25	12.91–15.69	21.46	19.82–23.21
TOTAL	**3.51**	**3.45–3.57**	**2.54**	**2.50–2.59**	**6.06**	**5.98–6.13**	**8.52**	**8.47–8.57**	**21.88**	**21.79–21.96**	**30.40**	**30.30–30.49**	**7.08**	**7.04–7.12**	**16.33**	**16.27–16.39**	**23.41**	**23.34–23.49**

a. Rates are per 100,000 and are age-adjusted to the 2000 United States standard population.
- Counts are not presented when fewer than 16 cases were reported for the specific category, or where the inclusion of the count and rate would allow for back-calculation of suppressed values. The suppressed cases are included in the counts and rates for Totals. Abbreviations: CBTRUS, Central Brain Tumor Registry of the United States; NPCR, National Program of Cancer Registries; SEER, Surveillance, Epidemiology, and End Results Program; CI, Confidence Interval

Table 11 Distribution of all histologically-confirmed brain and other central nervous system tumors by WHO grade, treatment information completeness, and major histology grouping, CBTRUS Statistical Report: U.S. Cancer Statistics – NPCR and SEER, 2012–2016

Histology	Number of Newly Diagnosed Tumors	Histologically Confirmed (%)	WHO Grade Completeness (%)			Assigned WHO Grade				Radiation Information Completeness[b] (%)	Surgical Extent of Resection Information Completeness[c] (%)
			Complete[a]	Incomplete	Not Applicable	WHO Grade I	WHO Grade II	WHO Grade III	WHO Grade IV		
Tumors of Neuroepithelial Tissue	**112,280**	**89.2%**	**85.6%**	**12.9%**	**1.5%**	**10.6%**	**14.0%**	**13.3%**	**62.0%**	**54.9%**	98.0%
Pilocytic Astrocytoma	5,166	90.8%	87.4%	12.1%	0.5%	92.9%	5.9%	0.8%	0.4%	6.0%	99.1%
Diffuse Astrocytoma	7,500	92.4%	85.6%	14.3%	0.1%	3.4%	64.1%	19.5%	13.0%	49.6%	97.7%
Anaplastic Astrocytoma	7,015	99.2%	94.8%	5.1%	0.1%	0.1%	1.3%	90.2%	8.5%	77.3%	99.2%
Unique Astrocytoma Variants	1,161	75.5%	75.8%	23.9%	0.3%	21.4%	55.3%	18.1%	5.3%	20.9%	98.2%
Malignant	*785*	*87.1%*	*78.4%*	*21.3%*	*0.3%*	*2.6%*	*68.5%*	*22.4%*	*6.5%*	*30.2%*	*97.9%*
Non-Malignant	*376*	*51.1%*	*66.7%*	*32.8%*	*0.5%*	*100.0%*	*0.0%*	*0.0%*	*0.0%*	*1.7%*	*98.8%*
Glioblastoma	59,164	93.2%	88.7%	11.2%	0.0%	0.2%	0.2%	0.8%	98.9%	69.4%	97.7%
Oligodendroglioma	3,668	96.9%	92.9%	7.1%	0.0%	1.5%	87.9%	5.8%	4.8%	32.7%	98.4%
Anaplastic Oligodendroglioma	1,808	98.9%	95.1%	4.9%	0.0%	0.1%	2.9%	88.7%	8.3%	69.3%	98.5%
Oligoastrocytic Tumors	2,103	99.2%	95.0%	5.0%	0.0%	0.8%	51.1%	40.1%	8.0%	56.5%	99.3%
Ependymal Tumors	6,877	89.2%	86.1%	13.9%	0.0%	36.2%	48.9%	14.1%	0.8%	26.2%	98.5%
Malignant	*4,005*	*93.6%*	*89.0%*	*11.0%*	*0.1%*	*2.5%*	*74.2%*	*22.1%*	*1.1%*	*38.2%*	*98.6%*
Non-Malignant	*2,872*	*82.9%*	*81.5%*	*18.5%*	*0.0%*	*94.1%*	*5.5%*	*0.3%*	*0.1%*	*9.4%*	*98.4%*
Glioma Malignant, NOS	7,751	33.8%	46.5%	52.4%	1.1%	18.2%	28.0%	25.3%	28.5%	27.5%	97.5%
Choroid Plexus Tumors	817	88.1%	76.1%	23.9%	0.0%	63.9%	18.8%	16.4%	0.9%	4.5%	98.2%
Malignant	*131*	*96.9%*	*82.7%*	*17.3%*	*0.0%*	*5.7%*	*3.8%*	*85.7%*	*4.8%*	*14.9%*	*100.0%*
Non-Malignant	*686*	*86.4%*	*74.7%*	*25.3%*	*0.0%*	*77.7%*	*22.3%*	*0.0%*	*0.0%*	*2.5%*	*98.0%*
Other Neuroepithelial Tumors	109	93.6%	48.0%	51.0%	1.0%	8.2%	53.1%	26.5%	12.2%	37.6%	100.0%
Malignant	*72*	*98.6%*	*40.8%*	*57.7%*	*1.4%*	*10.3%*	*24.1%*	*44.8%*	*20.7%*	*50.8%*	*100.0%*
Non-Malignant	*37*	*83.8%*	*64.5%*	*35.5%*	*0.0%*	*5.0%*	*95.0%*	*0.0%*	*0.0%*	*13.9%*	*100.0%*
Neuronal and Mixed Neuronal Glial Tumors	4,852	92.7%	62.7%	20.0%	17.3%	80.5%	15.1%	3.6%	0.7%	15.9%	98.6%
Malignant	*976*	*98.8%*	*16.3%*	*5.0%*	*78.7%*	*25.5%*	*8.9%*	*56.7%*	*8.9%*	*62.0%*	98.1%
Non-Malignant	*3,876*	*91.1%*	*75.4%*	*24.0%*	*0.5%*	*83.7%*	*15.5%*	*0.5%*	*0.3%*	*4.4%*	98.7%
Tumors of the Pineal Region	796	76.0%	0.0%	0.0%	100.0%	--	--	--	--	40.4%	97.7%
Malignant	*445*	*95.7%*	*0.0%*	*0.0%*	*100.0%*	--	--	--	--	*65.2%*	*98.6%*
Non-Malignant	*351*	*51.0%*	*0.0%*	*0.0%*	*100.0%*	--	--	--	--	*9.3%*	*97.0%*

Table 11 Continued

Histology	Number of Newly Diagnosed Tumors	Histologically Confirmed (%)	WHO Grade Completeness (%)			Assigned WHO Grade				Radiation Information Completeness[b] (%)	Surgical Extent of Resection Information Completeness[c] (%)
			Complete[a]	Incomplete	Not Applicable	WHO Grade I	WHO Grade II	WHO Grade III	WHO Grade IV		
Embryonal Tumors	3,493	98.0%	75.2%	24.1%	0.7%	1.4%	0.2%	1.4%	97.0%	61.9%	97.6%
Tumors of Cranial and Spinal Nerves	**35,053**	**50.6%**	**34.1%**	**65.9%**	**0.0%**	**99.0%**	**0.5%**	**0.2%**	**0.2%**	**18.2%**	98.2%
Nerve Sheath Tumors	35,017	50.6%	34.1%	65.9%	0.0%	99.0%	0.5%	0.2%	0.2%	18.2%	98.2%
Malignant	*231*	*80.5%*	*21.5%*	*78.5%*	*0.0%*	*47.5%*	*17.5%*	*20.0%*	*15.0%*	*38.6%*	*83.2%*
Non-Malignant	*34,786*	*50.4%*	*34.2%*	*65.8%*	*0.0%*	*99.4%*	*0.4%*	*0.1%*	*0.1%*	*18.1%*	*98.3%*
Other Tumors of Cranial and Spinal Nerves	36	41.7%	26.7%	73.3%	0.0%	100.0%	0.0%	0.0%	0.0%	2.8%	100.0%
Tumors of Meninges	**157,310**	**41.3%**	**77.7%**	**22.2%**	**0.1%**	**80.3%**	**17.5%**	**2.1%**	**0.1%**	**7.5%**	97.7%
Meningioma	152,756	40.0%	79.3%	20.7%	0.0%	80.5%	17.7%	1.7%	0.1%	7.2%	97.7%
Malignant	*1,774*	*79.0%*	*84.9%*	*15.1%*	*0.0%*	*21.9%*	*17.3%*	*59.6%*	*1.2%*	*38.4%*	*85.3%*
Non-Malignant	*150,982*	*39.5%*	*79.1%*	*20.8%*	*0.0%*	*82.0%*	*17.7%*	*0.2%*	*0.1%*	*6.9%*	*97.8%*
Mesenchymal Tumors	1,433	72.8%	52.3%	47.2%	0.5%	8.1%	47.4%	39.9%	4.6%	30.6%	98.1%
Primary Melanocytic Lesions	109	91.7%	13.0%	84.0%	3.0%	53.8%	30.8%	7.7%	7.7%	43.6%	89.7%
Other Neoplasms Related to the Meninges	3,012	91.5%	55.2%	43.4%	1.3%	99.2%	0.5%	0.1%	0.2%	7.3%	98.4%
Lymphoma and Hematopoietic Neoplasms	**7,914**	**94.6%**	**5.1%**	**94.0%**	**0.8%**	**100.0%**	**0.0%**	**0.0%**	**0.0%**	**22.0%**	99.2%
Lymphoma	7,680	94.8%	5.4%	94.2%	0.4%	100.0%	0.0%	0.0%	0.0%	21.7%	99.1%
Other Hematopoietic Neoplasms	234	88.5%	0.0%	88.8%	11.2%	--	--	--	--	31.7%	99.2%
Germ Cell Tumors and Cysts	**1,543**	**81.1%**	**3.0%**	**55.3%**	**41.8%**	**24.3%**	**5.4%**	**5.4%**	**64.9%**	**46.4%**	98.5%
Germ cell tumors, cysts, and heterotopias	1,543	81.1%	3.0%	55.3%	41.8%	24.3%	5.4%	5.4%	64.9%	46.4%	98.5%
Malignant	*1,037*	*88.4%*	*3.3%*	*43.4%*	*53.3%*	*6.7%*	*6.7%*	*6.7%*	*80.0%*	*68.0%*	98.7%
Non-Malignant	*506*	*66.2%*	*2.1%*	*87.8%*	*10.1%*	*100.0%*	*0.0%*	*0.0%*	*0.0%*	*2.5%*	97.9%
Tumors of Sellar Region	**71,084**	**48.3%**	**0.4%**	**0.6%**	**99.0%**	**100.0%**	**0.0%**	**0.0%**	**0.0%**	**3.2%**	97.8%
Tumors of the Pituitary	68,020	46.7%	0.0%	0.0%	100.0%	--	--	--	--	2.3%	97.8%
Malignant	*157*	*66.9%*	*0.0%*	*0.0%*	*100.0%*	--	--	--	--	*17.4%*	*87.0%*
Non-Malignant	*67,863*	*46.6%*	*0.0%*	*0.0%*	*100.0%*	--	--	--	--	*2.3%*	*97.8%*
Craniopharyngioma	3,064	83.5%	5.7%	7.5%	86.7%	100.0%	0.0%	0.0%	0.0%	22.0%	97.8%

Table 11 Continued

Histology	Number of Newly Diagnosed Tumors	Histologically Confirmed (%)	WHO Grade Completeness (%)			Assigned WHO Grade				Radiation Information Completeness[b] (%)	Surgical Extent of Resection Information Completeness[c] (%)
			Complete[a]	Incomplete	Not Applicable	WHO Grade I	WHO Grade II	WHO Grade III	WHO Grade IV		
Unclassified Tumors	**20,556**	**17.5%**	**4.4%**	**87.5%**	**8.1%**	**64.2%**	**8.2%**	**8.2%**	**19.5%**	**4.0%**	70.2%
Hemangioma	5,982	29.3%	2.3%	97.2%	0.5%	87.8%	7.3%	2.4%	2.4%	2.1%	97.6%
Neoplasm Unspecified	14,418	12.3%	6.1%	78.7%	15.3%	57.4%	9.3%	9.3%	24.1%	5.1%	60.3%
Malignant	*6,634*	*8.7%*	*7.7%*	*85.7%*	*6.6%*	*13.6%*	*11.4%*	*20.5%*	*54.5%*	*9.9%*	*42.7%*
Non-Malignant	*7,784*	*15.4%*	*5.3%*	*75.3%*	*19.4%*	*87.5%*	*7.8%*	*1.6%*	*3.1%*	*2.7%*	*75.8%*
All Other	156	38.5%	16.7%	66.7%	16.7%	40.0%	0.0%	20.0%	40.0%	12.7%	89.6%
TOTAL	**405,740**	**56.5%**	**62.9%**	**21.1%**	**16.0%**	**39.3%**	**14.7%**	**8.8%**	**37.3%**	**21.3%**	**95.9%**
Malignant	***122,569***	***85.3%***	***80.5%***	***17.5%***	***2.0%***	***6.2%***	***14.2%***	***15.0%***	***64.7%***	***54.8%***	**92.3%**
Non-Malignant	***283,171***	***44.1%***	***48.4%***	***24.0%***	***27.5%***	***84.3%***	***15.3%***	***0.3%***	***0.1%***	***7.1%***	**97.1%**

a. Completeness is defined as having an assigned code that corresponds with a WHO grade as defined by the American Joint Commission on Cancer's Collaborative Staging schema.
b. Radiation is defined using a recoded variable based on NAACCR Item #1360 (http://datadictionary.naaccr.org/default.aspx?c=10#136). Completeness is defined as having a value other than 'none' or 'unknown.'
c. Surgery is defined using a recoded variable based on NAACCR Item #1290 (http://datadictionary.naaccr.org/default.aspx?c=10#1290). Please see the SEER site-specific surgery codes for more information on coding for this variable (https://seer.cancer.gov/archive/tools/SEER2003.surg.prim.site.codes.pdf). Completeness is defined as having a value other than 'unknown.'
- Percentages are not presented when category is not applicable.
Abbreviations: CBTRUS, Central Brain Tumor Registry of the United States; CNS, central nervous system; NPCR, National Program of Cancer Registries; SEER, Surveillance, Epidemiology, and End Results Program; WHO, World Health Organization

Table 12 Five-year total, annual average total[a], and average annual age-adjusted incidence rates[b] with 95% confidence intervals for all brain and other central nervous system tumors by major histology grouping, histology, and race[c], CBTRUS Statistical Report: U.S. Cancer Statistics – NPCR and SEER, 2012–2016

Histology	White				Black				American Indian/Alaska Native				Asian/Pacific Islander			
	5-year Total	Annual average	Rate	95% CI	5-year Total	Annual average	Rate	95% CI	5-year Total	Annual average	Rate	95% CI	5-year Total	Annual average	Rate	95% CI
Tumors of Neuroepithelial Tissue	**98,423**	**19,685**	**7.09**	**7.04–7.13**	**8,480**	**1696**	**3.97**	**3.89–4.06**	**625**	**125**	**3.12**	**2.86–3.39**	**3,348**	**670**	**3.57**	**3.45–3.69**
Pilocytic Astrocytoma	4,218	844	0.38	0.36–0.39	601	120	0.26	0.24–0.28	38	8	0.15	0.10–0.20	200	40	0.22	0.19–0.26
Diffuse Astrocytoma	6,513	1,303	0.50	0.49–0.51	585	117	0.27	0.25–0.29	58	12	0.28	0.21–0.37	254	51	0.26	0.23–0.30
Anaplastic Astrocytoma	6,227	1,245	0.46	0.45–0.47	465	93	0.22	0.20–0.24	41	8	0.20	0.14–0.27	201	40	0.21	0.18–0.24
Unique Astrocytoma Variants	919	184	0.08	0.07–0.08	150	30	0.07	0.06–0.08	--	--	--	--	64	13	0.07	0.05–0.09
Malignant	*643*	*129*	*0.05*	*0.05–0.06*	*78*	*16*	*0.04*	*0.03–0.04*	--	--	--	--	*44*	*9*	*0.05*	*0.03–0.06*
Non-Malignant	*276*	*55*	*0.02*	*0.02–0.03*	*72*	*14*	*0.03*	*0.02–0.04*	--	--	--	--	*20*	*4*	*0.02*	*0.01–0.04*
Glioblastoma	53,426	10,685	3.49	3.46–3.52	3,647	729	1.79	1.73–1.85	242	48	1.43	1.25–1.64	1,345	269	1.46	1.38–1.54
Oligodendroglioma	3,200	640	0.26	0.25–0.27	247	49	0.12	0.10–0.13	28	6	0.12	0.08–0.18	126	25	0.13	0.10–0.15
Anaplastic Oligodendroglioma	1,576	315	0.12	0.11–0.13	101	20	0.05	0.04–0.06	--	--	--	--	89	18	0.09	0.07–0.11
Oligoastrocytic Tumors	1,860	372	0.15	0.14–0.16	123	25	0.06	0.05–0.07	--	--	--	--	72	14	0.07	0.05–0.09
Ependymal Tumors	5,890	1,178	0.46	0.45–0.47	565	113	0.26	0.24–0.28	50	10	0.22	0.17–0.30	251	50	0.26	0.23–0.29
Malignant	*3,372*	*674*	*0.27*	*0.26–0.28*	*375*	*75*	*0.17*	*0.15–0.19*	*25*	*5*	*0.11*	*0.07–0.16*	*161*	*32*	*0.17*	*0.14–0.20*
Non-Malignant	*2,518*	*504*	*0.19*	*0.19–0.20*	*190*	*38*	*0.09*	*0.07–0.10*	*25*	*5*	*0.12*	*0.07–0.17*	*90*	*18*	*0.09*	*0.07–0.11*
Glioma Malignant, NOS	6,415	1,283	0.51	0.49–0.52	869	174	0.40	0.38–0.43	48	10	0.22	0.16–0.29	277	55	0.30	0.27–0.34
Choroid Plexus Tumors	677	135	0.06	0.05–0.06	77	15	0.03	0.03–0.04	--	--	--	--	36	7	0.04	0.03–0.05
Malignant	*100*	*20*	*0.01*	*0.01-0.01*	*17*	*3*	*0.01*	*0.00–0.01*	--	--	--	--	--	--	--	--
Non-Malignant	*577*	*115*	*0.05*	*0.04–0.05*	*60*	*12*	*0.03*	*0.02–0.03*	--	--	--	--	--	--	--	--
Other Neuroepithelial Tumors	86	17	0.01	0.01-0.01	--	--	--	--	--	--	--	--	--	--	--	--
Malignant	*56*	*11*	*0.00*	*0.00–0.01*	--	--	--	--	--	--	--	--	--	--	--	--
Non-Malignant	*30*	*6*	*0.00*	*0.00-0.00*	--	--	--	--	--	--	--	--	--	--	--	--
Neuronal and Mixed Neuronal Glial Tumors	3,990	798	0.33	0.32–0.34	518	104	0.23	0.21–0.25	39	8	0.16	0.11–0.23	219	44	0.23	0.20–0.26
Malignant	*819*	*164*	*0.06*	*0.06-0.06*	*75*	*15*	*0.04*	*0.03–0.05*	--	--	--	--	*59*	*12*	*0.06*	*0.05–0.08*
Non-Malignant	*3,171*	*634*	*0.27*	*0.26–0.28*	*443*	*89*	*0.19*	*0.17–0.21*	*29*	*6*	*0.11*	*0.08–0.17*	*160*	*32*	*0.17*	*0.14–0.19*
Tumors of the Pineal Region	**630**	**126**	**0.05**	**0.05–0.06**	**116**	**23**	**0.05**	**0.04–0.06**	**--**	**--**	**--**	**--**	**29**	**6**	**0.03**	**0.02–0.04**
Malignant	*333*	*67*	*0.03*	*0.02–0.03*	*79*	*16*	*0.04*	*0.03–0.04*	--	--	--	--	--	--	--	--
Non-Malignant	*297*	*59*	*0.02*	*0.02–0.03*	*37*	*7*	*0.02*	*0.01–0.02*	--	--	--	--	--	--	--	--
Embryonal Tumors	**2,796**	**559**	**0.25**	**0.24–0.26**	**406**	**81**	**0.17**	**0.15–0.19**	**34**	**7**	**0.13**	**0.09–0.19**	**179**	**36**	**0.20**	**0.17–0.23**

Table 12 Continued

Histology	White				Black				American Indian/Alaska Native				Asian/Pacific Islander			
	5-year Total	Annual average	Rate	95% CI	5-year Total	Annual average	Rate	95% CI	5-year Total	Annual average	Rate	95% CI	5-year Total	Annual average	Rate	95% CI
Tumors of Cranial and Spinal Nerves	**29,894**	**5,979**	**2.11**	**2.09–2.14**	**2137**	**427**	**1.01**	**0.97–1.06**	**229**	**46**	**1.12**	**0.98–1.29**	**1,943**	**389**	**1.98**	**1.89–2.07**
Nerve Sheath Tumors	29,864	5,973	2.11	2.09–2.14	2,135	427	1.01	0.97–1.06	228	46	1.12	0.97–1.28	1,940	388	1.97	1.88–2.06
Malignant	*177*	*35*	*0.01*	*0.01–0.02*	*28*	*6*	*0.01*	*0.01–0.02*	--	--	--	--	--	--	--	--
Non-Malignant	*29,687*	*5,937*	*2.10*	*2.07–2.12*	*2107*	*421*	*1.00*	*0.96–1.04*	--	--	-	--	--	--	--	--
Other Tumors of Cranial and Spinal Nerves	30	6	0.00	0.00-0.00	--	--	--	--	--	--	--	--	--	--	--	--
Tumors of Meninges	**128,202**	**25,640**	**8.66**	**8.61–8.70**	**19,519**	**3,904**	**10.13**	**9.99–10.28**	**929**	**186**	**5.55**	**5.18–5.95**	**6,616**	**1,323**	**7.42**	**7.23–7.60**
Meningioma	124,430	24,886	8.37	8.32–8.42	19,053	3,811	9.92	9.77–10.06	902	180	5.43	5.06–5.82	6,400	1,280	7.20	7.02–7.38
Malignant	*1,396*	*279*	*0.09*	*0.09–0.10*	*269*	*54*	*0.14*	*0.12–0.16*	--	--	--	--	*83*	*17*	*0.09*	*0.07–0.12*
Non-Malignant	*123,034*	*24,607*	*8.28*	*8.23–8.32*	*18,784*	*3,757*	*9.78*	*9.63–9.92*	--	--	--	--	*6,317*	*1,263*	*7.10*	*6.93–7.29*
Mesenchymal Tumors	1,195	239	0.09	0.09–0.10	--	--	--	--	--	--	--	--	--	--	--	--
Primary Melanocytic Lesions	102	20	0.01	0.01-0.01	--	--	--	--	--	--	--	--	--	--	--	--
Other Neoplasms Related to the Meninges	2,475	495	0.19	0.18–0.20	325	65	0.15	0.13–0.17	22	4	0.10	0.06–0.16	137	27	0.14	0.11–0.16
Lymphoma and Hematopoietic Neoplasms	**6,691**	**1,338**	**0.45**	**0.44–0.46**	**6,25**	**125**	**0.31**	**0.28–0.33**	**46**	**9**	**0.26**	**0.19–0.36**	**446**	**89**	**0.50**	**0.45–0.55**
Lymphoma	6,504	1,301	0.43	0.42–0.44	597	119	0.29	0.27–0.32	--	--	--	--	--	--	--	--
Other Hematopoietic Neoplasms	187	37	0.01	0.01–0.02	28	6	0.01	0.01–0.02	--	--	--	--	--	--	--	--
Germ Cell Tumors and Cysts	**1,221**	**244**	**0.11**	**0.10–0.11**	**151**	**30**	**0.06**	**0.05–0.08**	**--**	**--**	**--**	**--**	**126**	**25**	**0.14**	**0.11–0.16**
Germ cell tumors, cysts, and heterotopias	1,221	244	0.11	0.10–0.11	151	30	0.06	0.05–0.08	--	--	--	--	126	25	0.14	0.11–0.16
Malignant	*813*	*163*	*0.07*	*0.07–0.08*	*94*	*19*	*0.04*	*0.03–0.05*	--	--	--	--	*101*	*20*	*0.11*	*0.09–0.14*
Non-Malignant	*408*	*82*	*0.03*	*0.03–0.04*	*57*	*11*	*0.03*	*0.02–0.03*	--	--	--	--	*25*	*5*	*0.03*	*0.02–0.04*
Tumors of Sellar Region	**51,448**	**10,290**	**3.88**	**3.84–3.91**	**13,875**	**2,775**	**6.75**	**6.64–6.87**	**636**	**127**	**3.20**	**2.94–3.47**	**3,669**	**734**	**3.76**	**3.63–3.88**
Tumors of the Pituitary	49,254	9,851	3.71	3.67–3.74	13,243	2,649	6.46	6.35–6.58	610	122	3.07	2.81–3.33	3,508	702	3.59	3.47–3.71
Malignant	*114*	*23*	*0.01*	*0.01-0.01*	*32*	*6*	*0.02*	*0.01–0.02*	--	--	--	--	--	--	--	--
Non-Malignant	*49,140*	*9,828*	*3.70*	*3.66–3.73*	*13,211*	*2,642*	*6.45*	*6.33–6.56*	--	--	--	--	--	--	--	--
Craniopharyngioma	2,194	439	0.17	0.16–0.18	632	126	0.29	0.27–0.32	26	5	0.13	0.08–0.19	161	32	0.17	0.14–0.20
Unclassified Tumors	**17,220**	**3,444**	**1.22**	**1.20–1.23**	**2,149**	**430**	**1.10**	**1.05–1.15**	**178**	**36**	**0.99**	**0.84–1.16**	**732**	**146**	**0.83**	**0.77–0.90**
Hemangioma	5,000	1,000	0.38	0.37–0.39	547	109	0.26	0.24–0.28	71	14	0.36	0.27–0.45	268	54	0.28	0.25–0.32
Neoplasm Unspecified	12,109	2,422	0.83	0.82–0.85	1,570	314	0.83	0.78–0.87	105	21	0.61	0.49–0.75	457	91	0.54	0.49–0.60
Malignant	*5,749*	*1,150*	*0.38*	*0.37–0.39*	*571*	*114*	*0.32*	*0.29–0.34*	*51*	*10*	*0.30*	*0.22–0.41*	*189*	*38*	*0.24*	*0.20–0.27*
Non-Malignant	*6,360*	*1,272*	*0.45*	*0.44–0.46*	*999*	*200*	*0.51*	*0.48–0.54*	*54*	*11*	*0.31*	*0.23–0.41*	*268*	*54*	*0.31*	*0.27–0.35*

Table 12 Continued

Histology	White				Black				American Indian/Alaska Native				Asian/Pacific Islander			
	5-year Total	Annual average	Rate	95% CI	5-year Total	Annual average	Rate	95% CI	5-year Total	Annual average	Rate	95% CI	5-year Total	Annual average	Rate	95% CI
All Other	111	22	0.01	0.01-0.01	32	6	0.02	0.01–0.02	--	--	--	--	--	--	--	--
TOTAL[d]	**333,099**	**66,620**	**23.50**	**23.42–23.59**	**46,936**	**9,387**	**23.34**	**23.13–23.56**	**2,652**	**530**	**14.28**	**13.70–14.87**	**16,880**	**3,376**	**18.18**	**17.90–18.46**
Malignant	***107,119***	***21,424***	***7.58***	***7.54–7.63***	***9356***	***1,871***	***4.48***	***4.38–4.57***	***677***	***135***	***3.51***	***3.24–3.81***	***3,928***	***786***	***4.25***	***4.12–4.39***
Non-Malignant	***225,980***	***45,196***	***15.92***	***15.85–15.99***	***37,580***	***7,516***	***18.87***	***18.67–19.06***	***1,975***	***395***	***10.76***	***10.26–11.28***	***12,952***	***2,590***	***13.93***	***13.68–14.17***

a. Annual average cases are calculated by dividing the five-year total by five.
b. Rates are per 100,000 and are age-adjusted to the 2000 US standard population.
c. Individuals with unknown race were excluded (N = 6173).
d. Refers to all brain tumors including histologies not presented in this table.
- Counts and rates are not presented when fewer than 16 cases were reported for the specific category, or where the inclusion of the count and rate would allow for back-calculation of suppressed values. The suppressed cases are included in the counts and rates for Totals.
Abbreviations: CBTRUS, Central Brain Tumor Registry of the United States; NPCR, National Program of Cancer Registries; SEER, Surveillance, Epidemiology, and End Results Program; CI, Confidence Interval; NOS, Not otherwise specified

Table 13 Five-year total, annual average total[a], and average annual age-adjusted incidence rates[b] with 95% confidence intervals for all brain and other central nervous system tumors by major histology grouping, histology, hispanic ethnicity[c], and race, CBTRUS Statistical Report: U.S. Cancer Statistics – NPCR and SEER, 2012–2016

Histology	All Hispanic				White Hispanic				Black Hispanic				All Non-Hispanic			
	5-year Total	Annual average	Rate	95% CI	5-year Total	Annual average	Rate	95% CI	5-year Total	Annual average	Rate	95% CI	5-year Total	Annual average	Rate	95% CI
Tumors of Neuroepithelial Tissue	**11,414**	**2,283**	**4.96**	**4.86–5.06**	**10,492**	**2,098**	**5.04**	**4.94–5.15**	**276**	**55**	**2.51**	**2.18–2.87**	**100,866**	**20,173**	**6.85**	**6.81–6.89**
Pilocytic Astrocytoma	826	165	0.25	0.23–0.27	744	149	0.25	0.23–0.27	25	5	0.13	0.08–0.20	4,340	868	0.38	0.37–0.39
Diffuse Astrocytoma	804	161	0.33	0.31–0.36	732	146	0.33	0.31–0.36	17	3	0.13	0.07–0.23	6,696	1,339	0.49	0.47–0.50
Anaplastic Astrocytoma	659	132	0.29	0.26–0.31	611	122	0.29	0.27–0.32	17	3	0.15	0.08–0.25	6,356	1,271	0.44	0.43–0.45
Unique Astrocytoma Variants	189	38	0.06	0.06–0.08	175	35	0.07	0.06–0.08	--	--	--	--	972	194	0.08	0.07–0.08
Malignant	*115*	*23*	*0.04*	*0.03–0.05*	*109*	*22*	*0.04*	*0.04–0.05*	--	--	--	--	*670*	*134*	*0.05*	*0.05–0.06*
Non-Malignant	*74*	*15*	*0.02*	*0.02–0.03*	*66*	*13*	*0.02*	*0.02–0.03*	--	--	--	--	*302*	*60*	*0.03*	*0.02–0.03*
Glioblastoma	4,491	898	2.41	2.33–2.48	4,208	842	2.46	2.39–2.54	111	22	1.35	1.09–1.65	54,673	10,935	3.31	3.29–3.34
Oligodendroglioma	429	86	0.17	0.15–0.18	386	77	0.17	0.15–0.18	--	--	--	--	3,239	648	0.25	0.24–0.26
Anaplastic Oligodendroglioma	217	43	0.09	0.08–0.11	199	40	0.09	0.08–0.11	--	--	--	--	1,591	318	0.11	0.11–0.12
Oligoastrocytic Tumors	223	45	0.09	0.08–0.10	207	41	0.09	0.08–0.11	--	--	--	--	1,880	376	0.14	0.14–0.15
Ependymal Tumors	950	190	0.36	0.34–0.39	858	172	0.36	0.34–0.39	18	4	0.15	0.08–0.26	5,927	1,185	0.44	0.43–0.45
Malignant	*632*	*126*	*0.23*	*0.21–0.25*	*580*	*116*	*0.24*	*0.22–0.26*	--	--	--	--	*3,373*	*675*	*0.25*	*0.25–0.26*
Non-Malignant	*318*	*64*	*0.13*	*0.12–0.15*	*278*	*56*	*0.13*	*0.11–0.14*	--	--	--	--	*2,554*	*511*	*0.18*	*0.18–0.19*
Glioma Malignant, NOS	966	193	0.37	0.34–0.40	874	175	0.37	0.35–0.40	30	6	0.20	0.13–0.31	6,785	1,357	0.52	0.50–0.53
Choroid Plexus Tumors	152	30	0.05	0.04–0.06	137	27	0.05	0.04–0.06	--	--	--	--	665	133	0.05	0.05–0.06
Malignant	*23*	*5*	*0.01*	*0.00–0.01*	*20*	*4*	*0.01*	*0.00–0.01*	--	--	--	--	*108*	*22*	*0.01*	*0.01-0.01*
Non-Malignant	*129*	*26*	*0.04*	*0.04–0.05*	*117*	*23*	*0.04*	*0.04–0.05*	--	--	--	--	*557*	*111*	*0.05*	*0.04–0.05*
Other Neuroepithelial Tumors	21	4	0.01	0.00–0.01	18	4	0.01	0.00–0.01	--	--	--	--	88	18	0.01	0.01-0.01
Malignant	--	--	--	--	--	--	--	--	--	--	--	--	*60*	*12*	*0.00*	*0.00–0.01*
Non-Malignant	--	--	--	--	--	--	--	--	--	--	--	--	*28*	*6*	*0.00*	*0.00-0.00*
Neuronal and Mixed Neuronal Glial Tumors	631	126	0.22	0.20–0.24	556	111	0.21	0.19–0.23	--	--	--	--	4,221	844	0.34	0.33–0.35
Malignant	*127*	*25*	*0.05*	*0.04–0.06*	*113*	*23*	*0.05*	*0.04–0.06*	--	--	--	--	*849*	*170*	*0.06*	*0.05–0.06*
Non-Malignant	*504*	*101*	*0.16*	*0.15–0.18*	*443*	*89*	*0.16*	*0.15–0.18*	--	--	--	--	*3,372*	*674*	*0.28*	*0.27–0.29*
Tumors of the Pineal Region	108	22	0.04	0.03–0.05	99	20	0.04	0.03–0.05	--	--	--	--	688	138	0.05	0.05–0.06
Malignant	*71*	*14*	*0.02*	*0.02–0.03*	*65*	*13*	*0.02*	*0.02–0.03*	--	--	--	--	*374*	*75*	*0.03*	*0.03-0.03*
Non-Malignant	*37*	*7*	*0.01*	*0.01–0.02*	*34*	*7*	*0.01*	*0.01–0.02*	--	--	--	--	*314*	*63*	*0.02*	*0.02–0.03*

Table 13 Continued

Histology	All Hispanic				White Hispanic				Black Hispanic				All Non-Hispanic			
	5-year Total	Annual average	Rate	95% CI	5-year Total	Annual average	Rate	95% CI	5-year Total	Annual average	Rate	95% CI	5-year Total	Annual average	Rate	95% CI
Embryonal Tumors	748	150	0.22	0.21–0.24	688	138	0.23	0.22–0.25	--	--	--	--	2,745	549	0.24	0.23–0.25
Tumors of Cranial and Spinal Nerves	**3,128**	**626**	**1.41**	**1.36–1.46**	**2,794**	**559**	**1.39**	**1.34–1.44**	**81**	**16**	**0.77**	**0.60–0.98**	**31,925**	**6,385**	**2.11**	**2.09–2.14**
Nerve Sheath Tumors	3,122	624	1.41	1.36–1.46	2,788	558	1.39	1.33–1.44	81	16	0.77	0.60–0.98	31,895	6,379	2.11	2.09–2.13
Malignant	*37*	*7*	*0.02*	*0.01–0.02*	*33*	*7*	*0.02*	*0.01–0.02*	--	--	--	--	*194*	*39*	*0.01*	*0.01–0.02*
Non-Malignant	*3,085*	*617*	*1.39*	*1.34–1.44*	*2,755*	*551*	*1.37*	*1.32–1.42*	--	--	--	--	*31,701*	*6,340*	*2.10*	*2.07–2.12*
Other Tumors of Cranial and Spinal Nerves	--	--	--	--	--	--	--	--	--	--	--	--	30	6	0.00	0.00-0.00
Tumors of Meninges	**15,279**	**3,056**	**8.36**	**8.22–8.50**	**13,917**	**2,783**	**8.32**	**8.18–8.47**	**438**	**88**	**5.56**	**5.01–6.15**	**142,031**	**28,406**	**8.93**	**8.89–8.98**
Meningioma	14,679	2,936	8.11	7.98–8.25	13,359	2,672	8.07	7.93–8.22	428	86	5.48	4.93–6.07	138,077	27,615	8.65	8.61–8.70
Malignant	*181*	*36*	*0.09*	*0.08–0.11*	*170*	*34*	*0.10*	*0.08–0.11*	--	--	--	--	*1,593*	*319*	*0.10*	*0.09–0.10*
Non-Malignant	*14,498*	*2,900*	*8.02*	*7.88–8.16*	*13,189*	*2,638*	*7.97*	*7.83–8.12*	--	--	--	--	*136,484*	*27,297*	*8.55*	*8.51–8.60*
Mesenchymal Tumors	206	41	0.09	0.07–0.10	193	39	0.09	0.08–0.10	--	--	--	--	1,227	245	0.09	0.08–0.09
Primary Melanocytic Lesions	--	--	--	--	--	--	--	--	--	--	--	--	99	20	0.01	0.01-0.01
Other Neoplasms Related to the Meninges	384	77	0.16	0.14–0.17	356	71	0.16	0.14–0.18	--	--	--	--	2,628	526	0.19	0.18–0.19
Lymphoma and Hematopoietic Neoplasms	**920**	**184**	**0.49**	**0.46–0.52**	**864**	**173**	**0.51**	**0.47–0.54**	**16**	**3**	**0.14**	**0.08–0.23**	**6,994**	**1,399**	**0.44**	**0.43–0.45**
Lymphoma	879	176	0.47	0.44–0.51	828	166	0.49	0.46–0.53	--	--	--	--	6,801	1,360	0.42	0.41–0.43
Other Hematopoietic Neoplasms	41	8	0.02	0.01–0.02	36	7	0.02	0.01–0.02	--	--	--	--	193	39	0.01	0.01–0.02
Germ Cell Tumors and Cysts	**334**	**67**	**0.10**	**0.09–0.12**	**300**	**60**	**0.10**	**0.09–0.12**	**--**	**--**	**--**	**--**	**1,209**	**242**	**0.10**	**0.10–0.11**
Germ cell tumors, cysts, and heterotopias	334	67	0.10	0.09–0.12	300	60	0.10	0.09–0.12	--	--	--	--	1,209	242	0.10	0.10–0.11
Malignant	*235*	*47*	*0.07*	*0.06–0.08*	*215*	*43*	*0.07*	*0.06–0.08*	--	--	--	--	*802*	*160*	*0.07*	*0.06–0.07*
Non-Malignant	*99*	*20*	*0.03*	*0.03–0.04*	*85*	*17*	*0.03*	*0.03–0.04*	--	--	--	--	*407*	*81*	*0.03*	*0.03–0.04*
Tumors of Sellar Region	**11,235**	**2,247**	**4.77**	**4.68–4.86**	**10,015**	**2,003**	**4.71**	**4.61–4.80**	**370**	**74**	**3.32**	**2.95–3.71**	**59,849**	**11,970**	**4.20**	**4.17–4.24**
Tumors of the Pituitary	10,775	2,155	4.60	4.51–4.69	9,593	1,919	4.53	4.44–4.63	357	71	3.24	2.88–3.63	57,245	11,449	4.01	3.98–4.04
Malignant	*28*	*6*	*0.01*	*0.01–0.02*	*22*	*4*	*0.01*	*0.01–0.02*	--	--	--	--	*129*	*26*	*0.01*	*0.01-0.01*
Non-Malignant	*10,747*	*2,149*	*4.58*	*4.49–4.68*	*9,571*	*1,914*	*4.52*	*4.42–4.62*	*356*	*71*	*3.23*	*2.87–3.62*	*57,116*	*11,423*	*4.00*	*3.97–4.03*

Table 13 Continued

Histology	All Hispanic				White Hispanic				Black Hispanic				All Non-Hispanic			
	5-year Total	Annual average	Rate	95% CI	5-year Total	Annual average	Rate	95% CI	5-year Total	Annual average	Rate	95% CI	5-year Total	Annual average	Rate	95% CI
Craniopharyngioma	460	92	0.17	0.16–0.19	422	84	0.18	0.16–0.20	--	--	--	--	2,604	521	0.19	0.19–0.20
Unclassified Tumors	**2,379**	**476**	**1.19**	**1.13–1.24**	**2,172**	**434**	**1.19**	**1.14–1.25**	**67**	**13**	**0.70**	**0.52–0.92**	**18,177**	**3,635**	**1.21**	**1.19–1.22**
Hemangioma	807	161	0.34	0.32–0.37	736	147	0.35	0.32–0.38	22	4	0.19	0.11–0.30	5,175	1,035	0.37	0.36–0.38
Neoplasm Unspecified	1,548	310	0.83	0.78–0.87	1,414	283	0.83	0.79–0.88	45	9	0.51	0.35–0.71	12,870	2,574	0.83	0.81–0.84
Malignant	*600*	*120*	*0.36*	*0.33–0.39*	*552*	*110*	*0.36*	*0.33–0.39*	--	--	--	--	*6,034*	*1,207*	*0.37*	*0.36–0.38*
Non-Malignant	*948*	*190*	*0.47*	*0.44–0.50*	*862*	*172*	*0.47*	*0.44–0.51*	--	--	--	--	*6,836*	*1,367*	*0.46*	*0.45–0.47*
All Other	24	5	0.01	0.01–0.02	22	4	0.01	0.01–0.02	--	--	--	--	132	26	0.01	0.01-0.01
TOTAL[d]	**44,689**	**8,938**	**21.28**	**21.07–21.49**	**40,554**	**8,111**	**21.27**	**21.05–21.49**	**1,257**	**251**	**13.04**	**12.25–13.87**	**361,051**	**72,210**	**23.84**	**23.76–23.92**
Malignant	***12,451***	***2,490***	***5.66***	***5.56–5.77***	***11,507***	***2,301***	***5.78***	***5.67–5.90***	***287***	***57***	***2.64***	***2.30–3.01***	***110,118***	***22,024***	***7.33***	***7.29–7.38***
Non-Malignant	***32,238***	***6,448***	***15.61***	***15.43–15.80***	***29,047***	***5,809***	***15.49***	***15.30–15.68***	***970***	***194***	***10.40***	***9.69–11.15***	***250,933***	***50,187***	***16.51***	***16.44–16.58***

a. Annual average cases are calculated by dividing the five-year total by five.
b. Rates are per 100,000 and are age-adjusted to the 2000 US standard population.
c. Hispanic ethnicity is not mutually exclusive of race; Classified using the North American Association of Central Cancer Registries Hispanic Identification Algorithm, version 2 (NHIA v2).
d. Refers to all brain tumors including histologies not presented in this table.
- Counts and rates are not presented when fewer than 16 cases were reported for the specific category, or where the inclusion of the count and rate would allow for back-calculation of suppressed values. The suppressed cases are included in the counts and rates for Totals.
Abbreviations: CBTRUS, Central Brain Tumor Registry of the United States; NPCR, National Program of Cancer Registries; SEER, Surveillance, Epidemiology, and End Results Program; CI, Confidence Interval; NOS, Not otherwise specified

Table 14 Five-year total, annual average total[a], and average annual age-adjusted incidence rates[b] with 95% confidence intervals for children and adolescents (age 0–19 years), brain and other central nervous system tumors by major histology grouping, histology, and sex, CBTRUS Statistical Report: U.S. Cancer Statistics – NPCR and SEER, 2012–2016

Histology	Total				Male				Female			
	5-year Total	Annual average	Rate	95% CI	5-year Total	Annual average	Rate	95% CI	5-year Total	Annual average	Rate	95% CI
Tumors of Neuroepithelial Tissue	**15,778**	**3,156**	**3.84**	**3.78–3.90**	**8,535**	**1,707**	**4.07**	**3.98–4.15**	**7,243**	**1,449**	**3.61**	**3.52–3.69**
Pilocytic Astrocytoma	3,730	746	0.91	0.88–0.94	1,948	390	0.93	0.89–0.97	1782	356	0.89	0.85–0.93
Diffuse Astrocytoma	968	194	0.24	0.22–0.25	508	102	0.24	0.22–0.26	460	92	0.23	0.21–0.25
Anaplastic Astrocytoma	406	81	0.10	0.09–0.11	229	46	0.11	0.10–0.12	177	35	0.09	0.08–0.10
Unique Astrocytoma Variants	519	104	0.13	0.12–0.14	292	58	0.14	0.12–0.16	227	45	0.11	0.10–0.13
Malignant	*243*	*49*	*0.06*	*0.05–0.07*	*139*	*28*	*0.07*	*0.06–0.08*	*104*	*21*	*0.05*	*0.04–0.06*
Non-Malignant	*276*	*55*	*0.07*	*0.06–0.08*	*153*	*31*	*0.07*	*0.06–0.09*	*123*	*25*	*0.06*	*0.05–0.07*
Glioblastoma	744	149	0.18	0.17–0.19	410	82	0.19	0.18–0.21	334	67	0.17	0.15–0.18
Oligodendroglioma	195	39	0.05	0.04–0.05	98	20	0.05	0.04–0.06	97	19	0.05	0.04–0.06
Anaplastic Oligodendroglioma	27	5	0.01	0.00–0.01	--	--	--	--	--	--	--	--
Oligoastrocytic Tumors	84	17	0.02	0.02–0.03	44	9	0.02	0.02–0.03	40	8	0.02	0.01–0.03
Ependymal Tumors	1,173	235	0.29	0.27–0.30	650	130	0.31	0.29–0.33	523	105	0.26	0.24–0.28
Malignant	*985*	*197*	*0.24*	*0.22–0.26*	*548*	*110*	*0.26*	*0.24–0.28*	*437*	*87*	*0.22*	*0.20–0.24*
Non-Malignant	*188*	*38*	*0.05*	*0.04–0.05*	*102*	*20*	*0.05*	*0.04–0.06*	*86*	*17*	*0.04*	*0.03–0.05*
Glioma Malignant, NOS	2,870	574	0.70	0.67–0.73	1,460	292	0.70	0.66–0.73	1,410	282	0.70	0.67–0.74
Choroid Plexus Tumors	409	82	0.10	0.09–0.11	230	46	0.11	0.10–0.12	179	36	0.09	0.08–0.10
Malignant	*105*	*21*	*0.03*	*0.02–0.03*	*53*	*11*	*0.03*	*0.02–0.03*	*52*	*10*	*0.03*	*0.02–0.03*
Non-Malignant	*304*	*61*	*0.07*	*0.07–0.08*	*177*	*35*	*0.08*	*0.07–0.10*	*127*	*25*	*0.06*	*0.05–0.08*
Other Neuroepithelial Tumors	38	8	0.01	0.01-0.01	--	--	--	--	--	--	--	--
Malignant	--	--	--	--	--	--	--	--	--	--	--	--
Non-Malignant	--	--	--	--	--	--	--	--	--	--	--	--
Neuronal and Mixed Neuronal Glial Tumors	1,889	378	0.46	0.44–0.48	1,041	208	0.49	0.47–0.53	848	170	0.42	0.39–0.45
Malignant	*100*	*20*	*0.02*	*0.02–0.03*	*59*	*12*	*0.03*	*0.02–0.04*	*41*	*8*	*0.02*	*0.01–0.03*
Non-Malignant	*1,789*	*358*	*0.43*	*0.41–0.46*	*982*	*196*	*0.47*	*0.44–0.50*	*807*	*161*	*0.40*	*0.37–0.43*
Tumors of the Pineal Region	218	44	0.05	0.05–0.06	111	22	0.05	0.04–0.06	107	21	0.05	0.04–0.06
Malignant	*180*	*36*	*0.04*	*0.04–0.05*	--	--	--	--	*81*	*16*	*0.04*	*0.03–0.05*
Non-Malignant	*38*	*8*	*0.01*	*0.01-0.01*	--	--	--	--	--	--	--	--
Embryonal Tumors	2,508	502	0.61	0.59–0.64	1,487	297	0.71	0.67–0.75	1,021	204	0.51	0.48–0.54
Medulloblastoma	*1,632*	*326*	*0.40*	*0.38–0.42*	*1,047*	*209*	*0.50*	*0.47–0.53*	*585*	*117*	*0.29*	*0.27–0.32*
Primitive Neuroectodermal Tumors	*270*	*54*	*0.07*	*0.06–0.07*	*139*	*28*	*0.07*	*0.06–0.08*	*131*	*26*	*0.07*	*0.05–0.08*

Table 14 Continued

Histology	Total				Male				Female			
	5-year Total	Annual average	Rate	95% CI	5-year Total	Annual average	Rate	95% CI	5-year Total	Annual average	Rate	95% CI
Atypical Teratoid/Rhabdoid Tumor	*370*	*74*	*0.09*	*0.08–0.10*	*180*	*36*	*0.09*	*0.07–0.10*	*190*	*38*	*0.09*	*0.08–0.11*
Other Embryonal Histologies[c]	*236*	*47*	*0.06*	*0.05–0.07*	*121*	*24*	*0.06*	*0.05–0.07*	*115*	*23*	*0.06*	*0.05–0.07*
Tumors of Cranial and Spinal Nerves	**1,336**	**267**	**0.32**	**0.31–0.34**	**716**	**143**	**0.34**	**0.32–0.37**	**620**	**124**	**0.31**	**0.28–0.33**
Nerve Sheath Tumors	1,333	267	0.32	0.31–0.34	713	143	0.34	0.31–0.36	620	124	0.31	0.28–0.33
Malignant	--	--	--	--	--	--	--	--	--	--	--	--
Non-Malignant	--	--	--	--	--	--	--	--	--	--	--	--
Other Tumors of Cranial and Spinal Nerves	--	--	--	--	--	--	--	--	--	--	--	--
Tumors of Meninges	**1,132**	**226**	**0.27**	**0.26–0.29**	**538**	**108**	**0.25**	**0.23–0.28**	**594**	**119**	**0.29**	**0.27–0.32**
Meningioma	653	131	0.16	0.15–0.17	299	60	0.14	0.13–0.16	354	71	0.17	0.16–0.19
Malignant	*37*	*7*	*0.01*	*0.01-0.01*	*16*	*3*	*0.01*	*0.00–0.01*	*21*	*4*	*0.01*	*0.01–0.02*
Non-Malignant	*616*	*123*	*0.15*	*0.14–0.16*	*283*	*57*	*0.13*	*0.12–0.15*	*333*	*67*	*0.16*	*0.15–0.18*
Mesenchymal Tumors	254	51	0.06	0.05–0.07	132	26	0.06	0.05–0.07	122	24	0.06	0.05–0.07
Primary Melanocytic Lesions	--	--	--	--	--	--	--	--	--	--	--	--
Other Neoplasms Related to the Meninges	--	--	--	--	--	--	--	--	--	--	--	--
Lymphoma and Hematopoietic Neoplasms	**131**	**26**	**0.03**	**0.03–0.04**	**82**	**16**	**0.04**	**0.03–0.05**	**49**	**10**	**0.02**	**0.02–0.03**
Lymphoma	64	13	0.02	0.01–0.02	42	8	0.02	0.01–0.03	22	4	0.01	0.01–0.02
Other Hematopoietic Neoplasms	67	13	0.02	0.01–0.02	40	8	0.02	0.01–0.03	27	5	0.01	0.01–0.02
Germ Cell Tumors and Cysts	**951**	**190**	**0.23**	**0.22–0.25**	**651**	**130**	**0.31**	**0.29–0.33**	**300**	**60**	**0.15**	**0.13–0.17**
Germ cell tumors, cysts, and heterotopias	951	190	0.23	0.22–0.25	651	130	0.31	0.29–0.33	300	60	0.15	0.13–0.17
Malignant	*733*	*147*	*0.18*	*0.17–0.19*	*531*	*106*	*0.25*	*0.23–0.27*	*202*	*40*	*0.10*	*0.09–0.12*
Non-Malignant	*218*	*44*	*0.05*	*0.05–0.06*	*120*	*24*	*0.06*	*0.05–0.07*	*98*	*20*	*0.05*	*0.04–0.06*
Tumors of Sellar Region	**4,080**	**816**	**0.98**	**0.95–1.01**	**1,301**	**260**	**0.62**	**0.58–0.65**	**2,779**	**556**	**1.37**	**1.32–1.42**
Tumors of the Pituitary	3,232	646	0.78	0.75–0.80	856	171	0.40	0.38–0.43	2,376	475	1.17	1.12–1.22
Malignant	--	--	--	--	--	--	--	--	--	--	--	--
Non-Malignant	--	--	--	--	--	--	--	--	--	--	--	--
Craniopharyngioma	848	170	0.21	0.19–0.22	445	89	0.21	0.19–0.23	403	81	0.20	0.18–0.22
Unclassified Tumors	**1,523**	**305**	**0.37**	**0.35–0.39**	**753**	**151**	**0.36**	**0.33–0.38**	**770**	**154**	**0.38**	**0.36–0.41**
Hemangioma	601	120	0.15	0.13–0.16	302	60	0.14	0.13–0.16	299	60	0.15	0.13–0.17

Table 14 Continued

Histology	Total				Male				Female			
	5-year Total	Annual average	Rate	95% CI	5-year Total	Annual average	Rate	95% CI	5-year Total	Annual average	Rate	95% CI
Neoplasm Unspecified	886	177	0.22	0.20–0.23	432	86	0.21	0.19–0.23	454	91	0.23	0.21–0.25
Malignant	*225*	*45*	*0.05*	*0.05–0.06*	*116*	*23*	*0.06*	*0.05–0.07*	*109*	*22*	*0.05*	*0.04–0.07*
Non-Malignant	*661*	*132*	*0.16*	*0.15–0.17*	*316*	*63*	*0.15*	*0.13–0.17*	*345*	*69*	*0.17*	*0.15–0.19*
All Other	36	7	0.01	0.01-0.01	19	4	0.01	0.01-0.01	17	3	0.01	0.00–0.01
TOTAL[d]	**24,931**	**4,986**	**6.06**	**5.98–6.13**	**12,576**	**2,515**	**5.98**	**5.88–6.09**	**12,355**	**2,471**	**6.13**	**6.02–6.24**
Malignant	***14,421***	***2,884***	***3.51***	***3.45–3.57***	***7,922***	***1,584***	***3.77***	***3.69–3.86***	***6,499***	***1,300***	***3.24***	***3.16–3.32***
Non-Malignant	***10,510***	***2,102***	***2.54***	***2.50–2.59***	***4,654***	***931***	***2.21***	***2.15–2.27***	***5,856***	***1,171***	***2.89***	***2.82–2.97***

a. Annual average cases are calculated by dividing the five-year total by five.
b. Rates are per 100,000 and are age-adjusted to the 2000 US standard population.
c. ICD-O-3 histology and behavior codes: 8963/3, 9364/3, 9480/3, 9490/0, 9490/3, 9500/3, 9501/3, and 9502/3.
d. Refers to all brain tumors including histologies not presented in this table.
- Counts and rates are not presented when fewer than 16 cases were reported for the specific category, or where the inclusion of the count and rate would allow for back-calculation of suppressed values. The suppressed cases are included in the counts and rates for Totals.
Abbreviations: CBTRUS, Central Brain Tumor Registry of the United States; NPCR, National Program of Cancer Registries; SEER, Surveillance, Epidemiology, and End Results Program; CI, Confidence Interval; NOS, Not otherwise specified

Table 15 Five-year total, annual average total[a], and average annual age-adjusted incidence rates[b] with 95% confidence intervals for children and adolescents (age 0–19 years), brain and other central nervous system tumors by major histology grouping, histology, and race[c], CBTRUS Statistical Report: U.S. Cancer Statistics – NPCR and SEER, 2012–2016

Histology	White				Black				American Indian/Alaska Native				Asian/Pacific Islander			
	5-year Total	Annual average	Rate	95% CI	5-year Total	Annual average	Rate	95% CI	5-year Total	Annual average	Rate	95% CI	5-year Total	Annual average	Rate	95% CI
Tumors of Neuroepithelial Tissue	**12,505**	**2,501**	**4.04**	**3.97–4.11**	**2,021**	**404**	**2.95**	**2.82–3.08**	**142**	**28**	**1.85**	**1.56–2.18**	**750**	**150**	**3.01**	**2.80–3.23**
Pilocytic Astrocytoma	3,008	602	0.97	0.94–1.01	451	90	0.66	0.60–0.72	30	6	0.39	0.26–0.55	157	31	0.63	0.53–0.74
Diffuse Astrocytoma	779	156	0.25	0.23–0.27	113	23	0.17	0.14–0.20	--	--	--	--	45	9	0.18	0.13–0.24
Anaplastic Astrocytoma	318	64	0.10	0.09–0.11	55	11	0.08	0.06–0.11	--	--	--	--	23	5	0.09	0.06–0.14
Unique Astrocytoma Variants	390	78	0.13	0.11–0.14	82	16	0.12	0.10–0.15	--	--	--	--	32	6	0.13	0.09–0.18
Malignant	*194*	*39*	*0.06*	*0.05–0.07*	*25*	*5*	*0.04*	*0.02–0.05*	--	--	--	--	--	--	--	--
Non-Malignant	*196*	*39*	*0.06*	*0.05–0.07*	*57*	*11*	*0.08*	*0.06–0.11*	--	--	--	--	--	--	--	--
Glioblastoma	580	116	0.19	0.17–0.20	99	20	0.14	0.12–0.18	--	--	--	--	39	8	0.16	0.11–0.22
Oligodendroglioma	151	30	0.05	0.04–0.06	26	5	0.04	0.02–0.06	--	--	--	--	--	--	--	--
Anaplastic Oligodendroglioma	19	4	0.01	0.00–0.01	--	--	--	--	--	--	--	--	--	--	--	--
Oligoastrocytic Tumors	70	14	0.02	0.02–0.03	--	--	--	--	--	--	--	--	--	--	--	--
Ependymal Tumors	945	189	0.30	0.29–0.33	135	27	0.20	0.16–0.23	--	--	--	--	53	11	0.21	0.16–0.28
Malignant	*787*	*157*	*0.25*	*0.24–0.27*	*122*	*24*	*0.18*	*0.15–0.21*	--	--	--	--	*44*	*9*	*0.18*	*0.13–0.24*
Non-Malignant	*158*	*32*	*0.05*	*0.04–0.06*	--	--	--	--	--	--	--	--	--	--	--	--
Glioma Malignant, NOS	2,263	453	0.73	0.70–0.76	392	78	0.57	0.52–0.63	20	4	0.26	0.16–0.40	127	25	0.51	0.42–0.60
Choroid Plexus Tumors	319	64	0.10	0.09–0.12	54	11	0.08	0.06–0.10	--	--	--	--	24	5	0.10	0.06–0.14
Malignant	*78*	*16*	*0.03*	*0.02–0.03*	--	--	--	--	--	--	--	--	--	--	--	--
Non-Malignant	*241*	*48*	*0.08*	*0.07–0.09*	*39*	*8*	*0.06*	*0.04–0.08*	--	--	--	--	--	--	--	--
Other Neuroepithelial Tumors	28	6	0.01	0.01-0.01	--	--	--	--	--	--	--	--	--	--	--	--
Malignant	*21*	*4*	*0.01*	*0.00–0.01*	--	--	--	--	--	--	--	--	--	--	--	--
Non-Malignant	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Neuronal and Mixed Neuronal Glial Tumors	1,512	302	0.49	0.46–0.51	243	49	0.36	0.31–0.40	16	3	0.21	0.12–0.34	82	16	0.33	0.26–0.41
Malignant	*76*	*15*	*0.02*	*0.02–0.03*	*18*	*4*	*0.03*	*0.02–0.04*	--	--	--	--	--	--	--	--
Non-Malignant	*1,436*	*287*	*0.46*	*0.44–0.49*	*225*	*45*	*0.33*	*0.29–0.38*	--	--	--	--	--	--	--	--
Tumors of the Pineal Region	148	30	0.05	0.04–0.06	48	10	0.07	0.05–0.09	--	--	--	--	--	--	--	--
Malignant	*117*	*23*	*0.04*	*0.03–0.05*	*44*	*9*	*0.06*	*0.05–0.09*	--	--	--	--	--	--	--	--
Non-Malignant	*31*	*6*	*0.01*	*0.01-0.01*	--	--	--	--	--	--	--	--	--	--	--	--
Embryonal Tumors	1,975	395	0.64	0.61–0.67	304	61	0.44	0.39–0.49	26	5	0.33	0.22–0.49	144	29	0.58	0.49–0.68
Medulloblastoma	*1,307*	*261*	*0.42*	*0.40–0.45*	*173*	*35*	*0.25*	*0.22–0.29*	*18*	*4*	*0.23*	*0.14–0.37*	*101*	*20*	*0.40*	*0.33–0.49*
Primitive Neuroectodermal Tumors	*207*	*41*	*0.07*	*0.06–0.08*	*43*	*9*	*0.06*	*0.05–0.08*	--	--	--	--	--	--	--	--

Table 15 Continued

Histology	White				Black				American Indian/Alaska Native				Asian/Pacific Islander			
	5-year Total	Annual average	Rate	95% CI	5-year Total	Annual average	Rate	95% CI	5-year Total	Annual average	Rate	95% CI	5-year Total	Annual average	Rate	95% CI
Atypical Teratoid/Rhabdoid Tumor	*275*	*55*	*0.09*	*0.08–0.10*	*59*	*12*	*0.08*	*0.06–0.11*	--	--	--	--	*25*	*5*	*0.10*	*0.06–0.15*
Other Embryonal Histologies[d]	*186*	*37*	*0.06*	*0.05–0.07*	*29*	*6*	*0.04*	*0.03–0.06*	--	--	--	--	--	--	--	--
Tumors of Cranial and Spinal Nerves	**1,034**	**207**	**0.33**	**0.31–0.35**	**170**	**34**	**0.25**	**0.21–0.29**	**--**	**--**	**--**	**--**	**75**	**15**	**0.30**	**0.24–0.38**
Nerve Sheath Tumors	1,031	206	0.33	0.31–0.35	170	34	0.25	0.21–0.29	--	--	--	--	75	15	0.30	0.24–0.38
Malignant	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Non-Malignant	*1,020*	*204*	*0.33*	*0.31–0.35*	*166*	*33*	*0.24*	*0.21–0.28*	--	--	--	--	*75*	*15*	*0.30*	*0.24–0.38*
Other Tumors of Cranial and Spinal Nerves	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Tumors of Meninges	**901**	**180**	**0.29**	**0.27–0.31**	**146**	**29**	**0.21**	**0.18–0.25**	**--**	**--**	**--**	**--**	**51**	**10**	**0.21**	**0.15–0.27**
Meningioma	514	103	0.16	0.15–0.18	92	18	0.13	0.11–0.16	--	--	--	--	28	6	0.11	0.08–0.16
Malignant	*30*	*6*	*0.01*	*0.01-0.01*	--	--	--	--	--	--	--	--	--	--	--	--
Non-Malignant	*484*	*97*	*0.15*	*0.14–0.17*	*87*	*17*	*0.13*	*0.10–0.16*	--	--	--	--	*26*	*5*	*0.11*	*0.07–0.16*
Mesenchymal Tumors	201	40	0.06	0.06–0.07	28	6	0.04	0.03–0.06	--	--	--	--	16	3	0.06	0.04–0.10
Primary Melanocytic Lesions	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Other Neoplasms Related to the Meninges	174	35	0.06	0.05–0.06	26	5	0.04	0.02–0.06	--	--	--	--	--	--	--	--
Lymphoma and Hematopoietic Neoplasms	**97**	**19**	**0.03**	**0.03–0.04**	**--**	**--**	**--**	**--**	**--**	**--**	**--**	**--**	**17**	**3**	**0.07**	**0.04–0.11**
Lymphoma	46	9	0.01	0.01–0.02	--	--	--	--	--	--	--	--	--	--	--	--
Other Hematopoietic Neoplasms	51	10	0.02	0.01–0.02	--	--	--	--	--	--	--	--	--	--	--	--
Germ Cell Tumors and Cysts	**739**	**148**	**0.24**	**0.22–0.26**	**93**	**19**	**0.14**	**0.11–0.17**	**--**	**--**	**--**	**--**	**88**	**18**	**0.36**	**0.29–0.44**
Germ cell tumors, cysts, and heterotopias	739	148	0.24	0.22–0.26	93	19	0.14	0.11–0.17	--	--	--	--	88	18	0.36	0.29–0.44
Malignant	*571*	*114*	*0.18*	*0.17–0.20*	*66*	*13*	*0.10*	*0.08–0.12*	--	--	--	--	*76*	*15*	*0.31*	*0.24–0.39*
Non-Malignant	*168*	*34*	*0.05*	*0.05–0.06*	*27*	*5*	*0.04*	*0.03–0.06*	--	--	--	--	--	--	--	--
Tumors of Sellar Region	**3,055**	**611**	**0.97**	**0.94–1.01**	**605**	**121**	**0.88**	**0.81–0.96**	**59**	**12**	**0.79**	**0.60–1.02**	**231**	**46**	**0.94**	**0.82–1.07**
Tumors of the Pituitary	2,436	487	0.77	0.74–0.80	449	90	0.65	0.59–0.72	52	10	0.70	0.52–0.91	183	37	0.74	0.64–0.86
Malignant	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Non-Malignant	*2,435*	*487*	*0.77*	*0.74–0.80*	*449*	*90*	*0.65*	*0.59–0.72*	*51*	*10*	*0.68*	*0.51–0.90*	*182*	*36*	*0.74*	*0.64–0.86*
Craniopharyngioma	619	124	0.20	0.18–0.22	156	31	0.23	0.20–0.27	--	--	--	--	48	10	0.19	0.14–0.26
Unclassified Tumors	**1,200**	**240**	**0.39**	**0.36–0.41**	**184**	**37**	**0.27**	**0.23–0.31**	**24**	**5**	**0.32**	**0.20–0.47**	**71**	**14**	**0.29**	**0.22–0.36**
Hemangioma	497	99	0.16	0.15–0.17	54	11	0.08	0.06–0.10	--	--	--	--	28	6	0.11	0.07–0.16

Table 15 Continued

Histology	White				Black				American Indian/Alaska Native				Asian/Pacific Islander			
	5-year Total	Annual average	Rate	95% CI	5-year Total	Annual average	Rate	95% CI	5-year Total	Annual average	Rate	95% CI	5-year Total	Annual average	Rate	95% CI
Neoplasm Unspecified	678	136	0.22	0.20–0.24	122	24	0.18	0.15–0.21	18	4	0.24	0.14–0.38	43	9	0.17	0.13–0.23
Malignant	*162*	*32*	*0.05*	*0.04–0.06*	*37*	*7*	*0.05*	*0.04–0.07*	--	--	--	--	--	--	--	--
Non-Malignant	*516*	*103*	*0.17*	*0.15–0.18*	*85*	*17*	*0.12*	*0.10–0.15*	--	--	--	--	*28*	*6*	*0.11*	*0.08–0.16*
All Other	25	5	0.01	0.01-0.01	--	--	--	--	--	--	--	--	--	--	--	--
TOTAL[e]	**19,531**	**3,906**	**6.29**	**6.20–6.37**	**3,231**	**646**	**4.71**	**4.55–4.88**	**256**	**51**	**3.37**	**2.97–3.80**	**1,283**	**257**	**5.17**	**4.89–5.46**
Malignant	***11,393***	***2,279***	***3.68***	***3.61–3.75***	***1,821***	***364***	***2.66***	***2.54–2.78***	***139***	***28***	***1.81***	***1.52–2.14***	***742***	***148***	***2.98***	***2.77–3.20***
Non-Malignant	***8,138***	***1,628***	***2.61***	***2.55–2.66***	***1,410***	***282***	***2.06***	***1.95–2.17***	***117***	***23***	***1.56***	***1.29–1.86***	***541***	***108***	***2.19***	***2.01–2.38***

a. Annual average cases are calculated by dividing the five-year total by five.
b. Rates are per 100,000 and are age-adjusted to the 2000 US standard population.
c. Individuals with unknown race were excluded (N = 630).
d. ICD-O-3 histology and behavior codes: 8963/3, 9364/3, 9480/3, 9490/0, 9490/3, 9500/3, 9501/3, and 9502/3.
e. Refers to all brain tumors including histologies not presented in this table.
- Counts and rates are not presented when fewer than 16 cases were reported for the specific category, or where the inclusion of the count and rate would allow for back-calculation of suppressed values. The suppressed cases are included in the counts and rates for Totals.
Abbreviations: CBTRUS, Central Brain Tumor Registry of the United States; NPCR, National Program of Cancer Registries; SEER, Surveillance, Epidemiology, and End Results Program; CI, Confidence Interval; NOS, Not otherwise specified

Table 16 Five-year total, annual average total[a], and average annual age-adjusted incidence rates[b] with 95% confidence intervals for children and adolescents (age 0–19 years), brain and other central nervous system tumors by major histology grouping, histology, hispanic ethnicity[c], and race, CBTRUS Statistical Report: U.S. Cancer Statistics – NPCR and SEER, 2012–2016

Histology	All Hispanic				White Hispanic				Black Hispanic				All Non-Hispanic			
	5-year total	Annual average	Rate	95% CI	5-year total	Annual average	Rate	95% CI	5-year total	Annual average	Rate	95% CI	5- year total	Annual average	Rate	95% CI
Tumors of Neuroepithelial Tissue	**2,942**	**588**	**2.93**	**2.82–3.03**	**2,679**	**536**	**3.02**	**2.91–3.14**	**82**	**16**	**1.35**	**1.07–1.67**	**12,836**	**2,567**	**4.13**	**4.06–4.21**
Pilocytic Astrocytoma	656	131	0.65	0.60–0.70	594	119	0.67	0.61–0.72	20	4	0.33	0.20–0.51	3,074	615	0.99	0.96–1.03
Diffuse Astrocytoma	131	26	0.13	0.11–0.16	119	24	0.14	0.11–0.16	--	--	--	--	837	167	0.27	0.25–0.29
Anaplastic Astrocytoma	86	17	0.09	0.07–0.11	78	16	0.09	0.07–0.11	--	--	--	--	320	64	0.10	0.09–0.11
Unique Astrocytoma Variants	115	23	0.12	0.10–0.14	105	21	0.12	0.10–0.15	--	--	--	--	404	81	0.13	0.12–0.14
Malignant	*57*	*11*	*0.06*	*0.04–0.08*	*54*	*11*	*0.06*	*0.05–0.08*	--	--	--	--	*186*	*37*	*0.06*	*0.05–0.07*
Non-Malignant	*58*	*12*	*0.06*	*0.04–0.07*	*51*	*10*	*0.06*	*0.04–0.08*	--	--	--	--	*218*	*44*	*0.07*	*0.06–0.08*
Glioblastoma	163	33	0.17	0.14–0.19	156	31	0.18	0.15–0.21	--	--	--	--	581	116	0.19	0.17–0.20
Oligodendroglioma	25	5	0.03	0.02–0.04	24	5	0.03	0.02–0.04	--	--	--	--	170	34	0.05	0.05–0.06
Anaplastic Oligodendroglioma	--	--	--	--	--	--	--	--	--	--	--	--	23	5	0.01	0.00–0.01
Oligoastrocytic Tumors	--	--	--	--	--	--	--	--	--	--	--	--	71	14	0.02	0.02–0.03
Ependymal Tumors	272	54	0.27	0.24–0.30	249	50	0.28	0.25–0.32	--	--	--	--	901	180	0.29	0.27–0.31
Malignant	*240*	*48*	*0.24*	*0.21–0.27*	*223*	*45*	*0.25*	*0.22–0.28*	--	--	--	--	*745*	*149*	*0.24*	*0.22–0.26*
Non-Malignant	*32*	*6*	*0.03*	*0.02–0.05*	*26*	*5*	*0.03*	*0.02–0.04*	--	--	--	--	*156*	*31*	*0.05*	*0.04–0.06*
Glioma Malignant, NOS	489	98	0.48	0.44–0.53	437	87	0.49	0.45–0.54	18	4	0.29	0.17–0.46	2,381	476	0.77	0.74–0.80
Choroid Plexus Tumors	90	18	0.09	0.07–0.11	80	16	0.09	0.07–0.11	--	--	--	--	319	64	0.10	0.09–0.12
Malignant	*20*	*4*	*0.02*	*0.01–0.03*	*18*	*4*	*0.02*	*0.01–0.03*	--	--	--	--	*85*	*17*	*0.03*	*0.02–0.03*
Non-Malignant	*70*	*14*	*0.07*	*0.05–0.09*	*62*	*12*	*0.07*	*0.05–0.09*	--	--	--	--	*234*	*47*	*0.08*	*0.07–0.09*
Other Neuroepithelial Tumors	--	--	--	--	--	--	--	--	--	--	--	--	30	6	0.01	0.01-0.01
Malignant	--	--	--	--	--	--	--	--	--	--	--	--	*24*	*5*	*0.01*	*0.00–0.01*
Non-Malignant	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Neuronal and Mixed Neuronal Glial Tumors	298	60	0.30	0.27–0.34	269	54	0.31	0.27–0.35	--	--	--	--	1,591	318	0.51	0.48–0.53
Malignant	*22*	*4*	*0.02*	*0.01–0.03*	*21*	*4*	*0.02*	*0.01–0.04*	--	--	--	--	*78*	*16*	*0.02*	*0.02–0.03*
Non-Malignant	*276*	*55*	*0.28*	*0.25–0.32*	*248*	*50*	*0.29*	*0.25–0.32*	--	--	--	--	*1,513*	*303*	*0.48*	*0.46–0.51*
Tumors of the Pineal Region	**44**	**9**	**0.04**	**0.03–0.06**	**37**	**7**	**0.04**	**0.03–0.06**	**--**	**--**	**--**	**--**	**174**	**35**	**0.06**	**0.05–0.06**
Malignant	*37*	*7*	*0.04*	*0.03–0.05*	*32*	*6*	*0.04*	*0.02–0.05*	--	--	--	--	*143*	*29*	*0.05*	*0.04–0.05*
Non-Malignant	--	--	--	--	--	--	--	--	--	--	--	--	*31*	*6*	*0.01*	*0.01-0.01*

Table 16 Continued

Histology	All Hispanic				White Hispanic				Black Hispanic				All Non-Hispanic			
	5-year total	Annual average	Rate	95% CI	5-year total	Annual average	Rate	95% CI	5-year total	Annual average	Rate	95% CI	5- year total	Annual average	Rate	95% CI
Embryonal Tumors	**548**	**110**	**0.53**	**0.49–0.58**	**507**	**101**	**0.56**	**0.51–0.61**	--	--	--	--	**1,960**	**392**	**0.64**	**0.61–0.67**
Medulloblastoma	*347*	*69*	*0.34*	*0.31–0.38*	*323*	*65*	*0.36*	*0.32–0.40*	--	--	--	--	*1,285*	*257*	*0.42*	*0.39–0.44*
Primitive Neuroectodermal Tumors	*63*	*13*	*0.06*	*0.05–0.08*	*57*	*11*	*0.06*	*0.05–0.08*	--	--	--	--	*207*	*41*	*0.07*	*0.06–0.08*
Atypical Teratoid/Rhabdoid Tumor	*91*	*18*	*0.09*	*0.07–0.11*	*85*	*17*	*0.09*	*0.07–0.11*	--	--	--	--	*279*	*56*	*0.09*	*0.08–0.10*
Other Embryonal Histologies[d]	*47*	*9*	*0.05*	*0.03–0.06*	*42*	*8*	*0.05*	*0.03–0.06*	--	--	--	--	*189*	*38*	*0.06*	*0.05–0.07*
Tumors of Cranial and Spinal Nerves	**238**	**48**	**0.24**	**0.21–0.27**	**207**	**41**	**0.24**	**0.21–0.27**	--	--	--	--	**1,098**	**220**	**0.35**	**0.33–0.37**
Nerve Sheath Tumors	237	47	0.24	0.21–0.27	206	41	0.24	0.21–0.27	--	--	--	--	1,096	219	0.35	0.33–0.37
Malignant	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Non-Malignant	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Other Tumors of Cranial and Spinal Nerves	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Tumors of Meninges	**227**	**45**	**0.23**	**0.21–0.27**	**205**	**41**	**0.24**	**0.21–0.27**	--	--	--	--	**905**	**181**	**0.29**	**0.27–0.30**
Meningioma	127	25	0.13	0.11–0.16	113	23	0.13	0.11–0.16	--	--	--	--	526	105	0.17	0.15–0.18
Malignant	--	--	--	--	--	--	--	--	--	--	--	--	*28*	*6*	*0.01*	*0.01-0.01*
Non-Malignant	--	--	--	--	--	--	--	--	--	--	--	--	*498*	*100*	*0.16*	*0.14–0.17*
Mesenchymal Tumors	52	10	0.05	0.04–0.07	46	9	0.05	0.04–0.07	--	--	--	--	202	40	0.07	0.06–0.07
Primary Melanocytic Lesions	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Other Neoplasms Related to the Meninges	46	9	0.05	0.04–0.06	44	9	0.05	0.04–0.07	--	--	--	--	167	33	0.05	0.04–0.06
Lymphoma and Hematopoietic Neoplasms	**28**	**6**	**0.03**	**0.02–0.04**	**24**	**5**	**0.03**	**0.02–0.04**	--	--	--	--	**103**	**21**	**0.03**	**0.03–0.04**
Lymphoma	--	--	--	--	--	--	--	--	--	--	--	--	50	10	0.02	0.01–0.02
Other Hemopoietic Neoplasms	--	--	--	--	--	--	--	--	--	--	--	--	53	11	0.02	0.01–0.02
Germ Cell Tumors and Cysts	**234**	**47**	**0.24**	**0.21–0.27**	**215**	**43**	**0.25**	**0.22–0.28**	--	--	--	--	**717**	**143**	**0.23**	**0.21–0.25**
Germ Cell Tumors, Cysts and Heterotopias	234	47	0.24	0.21–0.27	215	43	0.25	0.22–0.28	--	--	--	--	717	143	0.23	0.21–0.25
Malignant	*184*	*37*	*0.19*	*0.16–0.22*	*170*	*34*	*0.20*	*0.17–0.23*	--	--	--	--	*549*	*110*	*0.17*	*0.16–0.19*
Non-Malignant	*50*	*10*	*0.05*	*0.04–0.06*	*45*	*9*	*0.05*	*0.04–0.07*	--	--	--	--	*168*	*34*	*0.05*	*0.05–0.06*

Table 16 Continued

Histology	All Hispanic				White Hispanic				Black Hispanic				All Non-Hispanic			
	5-year total	Annual average	Rate	95% CI	5-year total	Annual average	Rate	95% CI	5-year total	Annual average	Rate	95% CI	5- year total	Annual average	Rate	95% CI
Tumors of Sellar Region	**1,100**	**220**	**1.16**	**1.09–1.23**	**971**	**194**	**1.15**	**1.08–1.22**	**34**	**7**	**0.61**	**0.42–0.85**	**2,980**	**596**	**0.93**	**0.90–0.97**
Tumors of the Pituitary	908	182	0.96	0.90–1.03	792	158	0.94	0.88–1.01	27	5	0.49	0.32–0.71	2,324	465	0.72	0.69–0.75
Malignant	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Non-Malignant	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Craniopharyngioma	192	38	0.19	0.17–0.22	179	36	0.20	0.18–0.24	--	--	--	--	656	131	0.21	0.20–0.23
Unclassified Tumors	**310**	**62**	**0.32**	**0.28–0.35**	**271**	**54**	**0.31**	**0.28–0.35**	**--**	**--**	**--**	**--**	**1,213**	**243**	**0.39**	**0.37–0.41**
Hemangioma	121	24	0.12	0.10–0.15	110	22	0.13	0.10–0.15	--	--	--	--	480	96	0.15	0.14–0.17
Neoplasm Unspecified	182	36	0.19	0.16–0.21	154	31	0.18	0.15–0.21	--	--	--	--	704	141	0.23	0.21–0.24
Malignant	*46*	*9*	*0.05*	*0.03–0.06*	*38*	*8*	*0.04*	*0.03–0.06*	--	--	--	--	*179*	*36*	*0.06*	*0.05–0.07*
Non-Malignant	*136*	*27*	*0.14*	*0.12–0.17*	*116*	*23*	*0.13*	*0.11–0.16*	--	--	--	--	*525*	*105*	*0.17*	*0.15–0.18*
All Other	--	--	--	--	--	--	--	--	--	--	--	--	29	6	0.01	0.01-0.01
TOTAL[e]	**5,079**	**1,016**	**5.14**	**5.00–5.29**	**4,572**	**914**	**5.23**	**5.08–5.39**	**145**	**29**	**2.45**	**2.06–2.88**	**19,852**	**3,970**	**6.35**	**6.26–6.44**
Malignant	***2,796***	***559***	***2.78***	***2.68–2.89***	***2,556***	***511***	***2.88***	***2.77–3.00***	***75***	***15***	***1.23***	***0.97–1.55***	***11,625***	***2,325***	***3.75***	***3.68–3.81***
Non-Malignant	***2,283***	***457***	***2.36***	***2.26–2.46***	***2,016***	***403***	***2.35***	***2.25–2.46***	***70***	***14***	***1.21***	***0.94–1.53***	***8,227***	***1,645***	***2.60***	***2.55–2.66***

a. Annual average cases are calculated by dividing the five-year total by five.
b. Rates are per 100,000 and are age-adjusted to the 2000 US standard population.
c. Hispanic ethnicity is not mutually exclusive of race; Classified using the North American Association of Central Cancer Registries Hispanic Identification Algorithm, version 2 (NHIA v2).
d. ICD-O-3 histology and behavior codes: 8963/3, 9364/3, 9480/3, 9490/0, 9490/3, 9500/3, 9501/3, and 9502/3.
e. Refers to all brain tumors including histologies not presented in this table.
- Counts and rates are not presented when fewer than 16 cases were reported for the specific category, or where the inclusion of the count and rate would allow for back-calculation of suppressed values. The suppressed cases are included in the counts and rates for Totals.
Abbreviations: CBTRUS, Central Brain Tumor Registry of the United States; NPCR, National Program of Cancer Registries; SEER, Surveillance, Epidemiology, and End Results Program; CI, Confidence Interval; NOS, Not otherwise specified

Table 17 Estimated number of cases[a,b] of brain and other central nervous system tumors overall and by behavior by state, 2019, 2020

State	2019 Estimated Cases			2020 Estimated Cases		
	All	Malignant	Non-Malignant	All	Malignant	Non-Malignant
Alabama	1,050	390	660	1,070	400	680
Alaska	190	60	130	200	60	130
Arizona	1,640	570	1,070	1,660	580	1,080
Arkansas	770	280	500	790	280	500
California	9,790	2,800	6,980	10,000	2,840	7,160
Colorado	1,650	430	1,230	1,690	440	1,250
Connecticut	1,000	310	680	1,020	310	700
Delaware	230	80	140	230	80	150
District of Columbia	190	--	--	200	--	--
Florida	6,430	17,60	4,670	6,540	1,780	4,760
Georgia	3,290	760	2,530	3,440	780	2,670
Hawaii	320	80	240	320	80	240
Idaho	450	150	310	470	150	320
Illinois	3,720	1,020	2,700	3,800	1,030	2,760
Indiana	1,720	550	1,170	1,750	560	1,190
Iowa	1,000	280	720	1,030	280	740
Kansas	840	240	600	860	240	620
Kentucky	1,520	450	1,070	1,550	460	1,090
Louisiana	1,420	340	1,080	1,480	350	1,130
Maine	320	140	180	320	140	180
Maryland	1,610	460	1,150	1,660	460	1,200
Massachusetts	1,360	520	850	1,360	520	850
Michigan	2,420	800	1,630	2,430	800	1,640
Minnesota	1,540	500	1,040	1,620	510	1,100
Mississippi	780	230	550	800	230	570
Missouri	1,750	520	1,230	1,780	520	1,260
Montana	300	100	200	310	100	200
Nebraska	450	160	280	450	160	290
Nevada	680	230	450	710	240	470
New Hampshire	380	130	250	390	140	250
New Jersey	2,970	760	2,210	3,080	770	2,310
New Mexico	470	150	320	480	150	330
NewYork	6,540	1,560	4,980	6,680	1,570	5,110
North Carolina	3,010	850	2,150	3,090	870	2,220
North Dakota	190	60	140	200	60	140
Ohio	3,070	1,020	2,050	3,150	1,030	2,120
Oklahoma	1,100	310	790	1,140	310	830
Oregon	970	380	590	980	380	600
Pennsylvania	4,250	1,220	3,030	4,320	1,240	3,090
Rhode Island	220	80	140	220	80	140
South Carolina	1,520	420	1,100	1,580	430	1,150
South Dakota	230	70	160	240	70	170
Tennessee	2,040	560	1,490	2,090	570	1,530
Texas	7,220	2,010	5,210	7,370	2,040	5,330
Utah	1,330	220	1,110	1,440	230	1,210
Vermont	180	60	130	180	60	130

Table 17 Continued

State	2019 Estimated Cases			2020 Estimated Cases		
	All	Malignant	Non-Malignant	All	Malignant	Non-Malignant
Virginia	1,850	670	1,180	1,870	690	1,190
Washington	2,830	670	2,170	2,940	680	2,260
West Virginia	500	160	340	510	160	350
Wisconsin	2,000	540	1,460	2,060	550	1,520
Wyoming	160	50	100	160	60	110
US TOTAL[c]	**86,010**	**25,510**	**60,490**	**87,240**	**25,800**	**61,430**

a. Source: Estimation based on CBTRUS NPCR and SEER 2000–2016 data for malignant tumors, and NPCR and SEER 2006–2016 data for non-malignant tumors.
b. Rounded to the nearest 10. Numbers may not add up due to rounding.
c. Total estimate is based on overall estimate. Histology-specific estimates may not add up to Total.
– Estimated number is less than 50. These cases are included in overall rates.
Abbreviations: CBTRUS, Central Brain Tumor Registry of the United States; NPCR, National Program of Cancer Registries; SEER, Surveillance, Epidemiology, and End Results Program

Table 18 Estimated number of cases[a,b] of brain and other central nervous system tumors overall and by behavior, by age, major histology grouping[c], and histology, 2019, 2020

Histology	2019 Estimated Cases								2020 Estimated Cases							
	All						Malignant	Non-Malignant	All						Malignant	Non-Malignant
	All Ages	0–14	0–19	15–39	40–64	65+	All Ages	All Ages	All Ages	0–14	0–19	15–39	40–64	65+	All Ages	All Ages
Tumors of Neuroepithelial Tissue	**23,440**	**2,530**	**2,950**	**3,760**	**8,550**	**8,600**	**21,600**	**1,840**	**23,720**	**2,530**	**2,940**	**3,810**	**8,600**	**8,790**	**21,850**	**1,870**
Pilocytic Astrocytoma	960	540	600	280	100	--	960	--	940	530	580	280	100	--	940	--
Diffuse Astrocytoma	1,340	130	170	460	420	330	1,340	--	1,310	120	160	460	400	330	1,310	--
Anaplastic Astrocytoma	1,640	60	80	500	660	410	1,640	--	1,690	70	90	530	670	420	1,690	--
Unique Astrocytoma Variants	250	80	100	90	--	--	180	80	260	90	100	90	--	50	180	80
Glioblastoma	12,900	110	160	570	5,430	6,780	12,900	--	13,140	120	170	580	5,490	6,950	13,140	--
Oligodendroglioma	680	--	--	250	340	70	680	--	660	--	--	240	330	70	660	--
Anaplastic Oligodendroglioma	380	--	--	110	210	60	380	--	390	--	--	110	210	60	390	--
Oligoastrocytic Tumors	50	--	--	--	--	--	50	--	--	--	--	--	--	--	--	--
Ependymal Tumors	1,410	200	230	380	560	280	770	640	1,420	200	230	380	560	290	760	660
Glioma Malignant, NOS	1,670	510	580	400	350	420	1,670	--	1,690	510	590	410	350	420	1,690	--
Choroid Plexus Tumors	160	70	60	--	--	--	--	130	160	70	60	--	--	--	--	130
Other Neuroepithelial Tumors	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Neuronal and Mixed Neuronal Glial Tumors	1,100	290	420	430	270	100	220	880	1,120	300	440	440	280	110	230	900
Tumors of the Pineal Region	190	--	--	70	70	--	110	80	200	--	--	70	70	--	120	80
Embryonal Tumors	700	470	450	170	50	--	670	--	690	470	450	170	--	--	670	--
Tumors of Cranial and Spinal Nerves	**7,520**	**160**	**250**	**1,140**	**4,010**	**2,210**	**--**	**7,480**	**7,640**	**150**	**250**	**1,160**	**4,070**	**2,250**	**--**	**7,600**
Nerve Sheath Tumors	7,510	160	250	1,140	4,000	2,210	--	7,470	7,620	150	250	1,160	4,070	2,250	--	7,580
Other Tumors of Cranial and Spinal Nerves	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Tumors of Meninges	**34,530**	**130**	**250**	**2,160**	**13,520**	**18,720**	**480**	**34,050**	**35,200**	**130**	**260**	**2,170**	**13,690**	**19,200**	**470**	**34,720**
Meningioma	33,560	60	140	1,900	13,110	18,490	300	33,260	34,210	60	140	1,910	13,280	18,970	290	33,920
Mesenchymal Tumors	310	60	60	60	120	80	100	210	320	60	60	60	120	80	100	220
Primary Melanocytic Lesions	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Other Neoplasms Related to the Meninges	630	--	50	200	280	140	50	570	630	--	50	200	280	140	50	570
Lymphoma and Hematopoietic Neoplasms	**1,740**	**--**	**--**	**110**	**580**	**1,020**	**1,740**	**--**	**1,770**	**--**	**--**	**110**	**580**	**1,050**	**1,770**	**--**
Lymphoma	1,670	--	--	90	570	1,010	1,670	--	1,690	--	--	90	570	1,040	1,690	--
Other Hematopoietic Neoplasms	70	--	--	--	--	--	70	--	80	--	--	--	--	--	80	--

Table 18 Continued

Histology	2019 Estimated Cases								2020 Estimated Cases							
	All						Malignant	Non-Malignant	All						Malignant	Non-Malignant
	All Ages	0–14	0–19	15–39	40–64	65+	All Ages	All Ages	All Ages	0–14	0–19	15–39	40–64	65+	All Ages	All Ages
Germ Cell Tumors and Cysts	**340**	**150**	**190**	**150**	**--**	**--**	**230**	**110**	**340**	**150**	**190**	**150**	**--**	**--**	**230**	**110**
Germ cell tumors, cysts, and heterotopias	340	150	190	150	--	--	230	110	340	150	190	150	--	--	230	110
Tumors of Sellar Region	**14,650**	**310**	**820**	**4,150**	**6,250**	**3,950**	**--**	**14,620**	**14,750**	**310**	**820**	**4,140**	**6,290**	**4,020**	**--**	**14,720**
Tumors of the Pituitary	14,020	170	650	4,010	6,020	3,820	--	13,990	14,120	170	650	4,000	6,050	3,890	--	14,090
Craniopharyngioma	630	140	170	140	230	120	--	630	640	140	170	130	230	130	--	630
Unclassified Tumors	**3,790**	**230**	**260**	**560**	**900**	**2,100**	**1,400**	**2,390**	**3,810**	**240**	**260**	**540**	**840**	**2,190**	**1,410**	**2,400**
Hemangioma	870	70	100	250	330	210	--	860	820	70	100	240	300	200	--	810
Neoplasm Unspecified	2,750	140	140	300	570	1,740	1,380	1,370	2,730	150	140	300	540	1,750	1,390	1,340
All Other	170	--	--	--	--	150	--	160	260	--	--	--	--	240	--	250
TOTAL[d]	**86,010**	**3,540**	**4,750**	**12,030**	**33,840**	**36,600**	**25,510**	**60,490**	**87,240**	**3,540**	**4,760**	**12,090**	**34,100**	**37,500**	**25,800**	**61,430**

a. Source: Estimation based on CBTRUS NPCR and SEER 2000–2016 data for malignant tumors, and NPCR and SEER 2006–2016 data for non-malignant tumors.
b. Rounded to the nearest 10. Numbers may not add up due to rounding.
c. Major histology grouping estimates are calculated by summing estimates for all included histologies.
d. Total estimate is based on overall estimate. Histology-specific estimates may not add up to Total.
– Estimated number is less than 50. These cases are included in overall rates.
Abbreviations: CBTRUS, Central Brain Tumor Registry of the United States; NPCR, National Program of Cancer Registries; SEER, Surveillance, Epidemiology, and End Results Program

Table 19 Five-year total, average annual total[a], and average annual age-adjusted mortality rates[b] for malignant brain and other central nervous system cancer overall and by state and sex, United States, 2012-2016[c]

State	Total				Male				Female			
	5-year Total	Annual average	Rate	95% CI	5-year Total	Annual average	Rate	95% CI	5-year Total	Annual average	Rate	95% CI
Alabama	1,470	294	5.18	4.91–5.46	816	163	6.34	5.90–6.80	654	131	4.23	3.90–4.58
Alaska	141	28	4.13	3.42–4.93	74	15	4.28	3.26–5.50	67	13	3.97	3.03–5.11
Arizona	1,704	341	4.41	4.20–4.63	961	192	5.25	4.92–5.60	743	149	3.66	3.39–3.94
Arkansas	889	178	5.12	4.78–5.48	489	98	6.16	5.62–6.75	400	80	4.29	3.87–4.74
California	8,885	1,777	4.38	4.29–4.48	5,039	1,008	5.39	5.24–5.54	3,846	769	3.53	3.41–3.64
Colorado	1,255	251	4.44	4.19–4.70	682	136	5.11	4.72–5.52	573	115	3.87	3.55–4.20
Connecticut	927	185	4.28	4.00–4.57	532	106	5.43	4.96–5.92	395	79	3.30	2.97–3.66
Delaware	248	50	4.35	3.81–4.95	130	26	5.08	4.22–6.07	118	24	3.82	3.14–4.61
Washington DC	78	16	2.40	1.89–3.02	46	9	3.11	2.26–4.19	32	6	1.82	1.23–2.60
Florida	5,491	1,098	4.19	4.08–4.31	3,070	614	5.09	4.91–5.28	2,421	484	3.39	3.25–3.53
Georgia	2,212	442	4.25	4.07–4.43	1,242	248	5.23	4.94–5.55	970	194	3.42	3.21–3.65
Hawaii	245	49	2.83	2.48–3.22	139	28	3.35	2.80–3.98	106	21	2.35	1.91–2.87
Idaho	468	94	5.16	4.69–5.66	296	59	6.88	6.09–7.73	172	34	3.59	3.07–4.19
Illinois	3,020	604	4.20	4.05–4.36	1,694	339	5.16	4.91–5.42	1,326	265	3.40	3.22–3.60
Indiana	1,712	342	4.63	4.41–4.86	976	195	5.69	5.33–6.06	736	147	3.75	3.48–4.04
Iowa	938	188	5.10	4.77–5.45	532	106	6.20	5.67–6.76	406	81	4.09	3.69–4.53
Kansas	819	164	5.03	4.68–5.40	471	94	6.17	5.62–6.77	348	70	4.04	3.62–4.51
Kentucky	1,252	250	4.92	4.64–5.20	696	139	5.89	5.45–6.36	556	111	4.06	3.72–4.42
Louisiana	1,106	221	4.34	4.09–4.61	618	124	5.34	4.91–5.79	488	98	3.53	3.22–3.86
Maine	451	90	5.06	4.58–5.58	277	55	6.64	5.85–7.51	174	35	3.70	3.14–4.34
Maryland	1,356	271	4.08	3.86–4.31	755	151	5.01	4.65–5.39	601	120	3.32	3.05–3.60
Massachusetts	1,777	355	4.49	4.28–4.71	993	199	5.56	5.21–5.92	784	157	3.61	3.35–3.88
Michigan	2,780	556	4.70	4.52–4.88	1,568	314	5.73	5.44–6.03	1,212	242	3.81	3.60–4.04
Minnesota	1,438	288	4.68	4.43–4.93	859	172	5.91	5.51–6.33	579	116	3.57	3.28–3.89
Mississippi	880	176	5.29	4.94–5.66	466	93	6.29	5.72–6.91	414	83	4.51	4.07–4.97
Missouri	1,571	314	4.37	4.15–4.60	869	174	5.31	4.95–5.68	702	140	3.58	3.31–3.86
Montana	306	61	4.72	4.19–5.31	176	35	5.67	4.83–6.61	130	26	3.80	3.15–4.55
Nebraska	527	105	5.04	4.61–5.50	298	60	6.11	5.42–6.86	229	46	4.12	3.58–4.71
Nevada	690	138	4.40	4.07–4.75	388	78	5.04	4.54–5.59	302	60	3.78	3.36–4.24
New Hampshire	397	79	4.88	4.39–5.40	236	47	6.13	5.35–7.01	161	32	3.83	3.23–4.50
New Jersey	2,092	418	4.02	3.84–4.20	1,172	234	4.96	4.68–5.26	920	184	3.24	3.03–3.46

Table 19 Continued

State	Total				Male				Female			
	5-year Total	Annual average	Rate	95% CI	5-year Total	Annual average	Rate	95% CI	5-year Total	Annual average	Rate	95% CI
New Mexico	434	87	3.60	3.26–3.97	237	47	4.15	3.62–4.73	197	39	3.12	2.69–3.60
New York	4,385	877	3.84	3.72–3.96	2,370	474	4.61	4.42–4.80	2,015	403	3.21	3.07–3.36
North Carolina	2,459	492	4.36	4.19–4.54	1,362	272	5.36	5.07–5.66	1,097	219	3.52	3.31–3.74
North Dakota	181	36	4.33	3.71–5.03	109	22	5.59	4.57–6.77	72	14	3.29	2.56–4.18
Ohio	3,176	635	4.60	4.44–4.77	1,831	366	5.78	5.51–6.06	1,345	269	3.60	3.41–3.81
Oklahoma	1,017	203	4.70	4.41–5.00	571	114	5.72	5.25–6.22	446	89	3.82	3.47–4.20
Oregon	1,198	240	5.04	4.75–5.34	686	137	6.08	5.62–6.57	512	102	4.10	3.74–4.48
Pennsylvania	3,514	703	4.42	4.27–4.58	1,964	393	5.41	5.16–5.66	1,550	310	3.61	3.42–3.80
Rhode Island	297	59	4.67	4.14–5.26	168	34	5.77	4.90–6.74	129	26	3.72	3.08–4.45
South Carolina	1,288	258	4.49	4.25–4.75	741	148	5.69	5.27–6.13	547	109	3.49	3.20–3.81
South Dakota	264	53	5.29	4.66–6.00	150	30	6.31	5.32–7.44	114	23	4.48	3.66–5.43
Tennessee	1,784	357	4.75	4.53–4.98	1,029	206	5.99	5.62–6.38	755	151	3.69	3.42–3.97
Texas	5,548	1,110	4.22	4.10–4.33	3,080	616	5.03	4.85–5.22	2,468	494	3.52	3.38–3.66
Utah	599	120	4.68	4.30–5.08	361	72	5.96	5.35–6.63	238	48	3.52	3.08–4.00
Vermont	212	42	5.44	4.70–6.26	114	23	6.20	5.07–7.52	98	20	4.78	3.84–5.89
Virginia	1,902	380	4.12	3.93–4.31	1,014	203	4.81	4.51–5.12	888	178	3.56	3.32–3.81
Washington	1,963	393	4.96	4.74–5.19	1,128	226	6.02	5.67–6.40	835	167	4.02	3.74–4.31
West Virginia	564	113	4.70	4.31–5.13	325	65	5.76	5.13–6.45	239	48	3.77	3.29–4.31
Wisconsin	1,644	329	4.86	4.62–5.11	921	184	5.77	5.40–6.17	723	145	4.03	3.73–4.34
Wyoming	164	33	5.01	4.24–5.87	84	17	5.33	4.21–6.66	80	16	4.80	3.76–6.03
US TOTAL	**79,718**	**15,944**	**4.42**	**4.38–4.45**	**44,805**	**8,961**	**5.38**	**5.33–5.44**	**34,913**	**6,983**	**3.59**	**3.55–3.63**

a. Annual average deaths are calculated by dividing the five-year total by five.
b. Rates are per 100,000 and are age-adjusted to the 2000 US standard population.
*c. Estimated by CBTRUS using Surveillance, Epidemiology, and End Results (SEER) Program (www.seer.cancer.gov) SEER*Stat Database: Mortality - All COD, Aggregated With State, Total U.S. (1990–2016) <Katrina/Rita Population Adjustment>, National Cancer Institute, DCCPS, Surveillance Research Program, released December 2018. Underlying mortality data provided by NCHS (www.cdc.gov/nchs).*
- Counts and rates are not presented when fewer than 16 cases were reported for the specific category, or where the inclusion of the count and rate would allow for back-calculation of suppressed values. The suppressed cases are included in the counts and rates for Totals.
Abbreviations: NCHS, National Center for Health Statistics; CI, Confidence Interval.

Table 20 One-, five-, and ten-year relative survival rates[a,b] with 95% confidence intervals for all primary brain and other central nervous system tumors by behavior and site, U.S. Cancer Statistics – NPCR Registries, 2001–2015 (varying)

Site (ICD-O Topography Code)	Malignant (2001–2015)							Non-Malignant (2004–2015)						
	N[c]	1-Year		5-Year		10-Year		N[c]	1-Year		5-Year		10-Year	
		%	95% CI	%	95% CI	%	95% CI		%	95% CI	%	95% CI	%	95% CI
Cerebrum (C71.0)	13,173	52.9	52.0–53.8	29.8	28.9–30.6	26.1	52.0-27.1	2,328	88.6	87.1–89.9	84.3	82.3–86.1	77.6	87.1-80.6
Frontal lobe (C71.1)	64,405	61.4	61.0–61.8	34.8	34.4–35.2	27.6	61.0-28.0	6,534	89.5	88.6–90.2	84.2	82.9–85.3	79.4	88.6-81.2
Temporal lobe (C71.2)	47,133	58.1	57.6–58.5	23.9	23.5–24.3	18.6	57.6-19.1	5,460	93.4	92.6–94.1	90.5	89.5–91.5	88.5	92.6-89.8
Parietal lobe (C71.3)	30,558	50.9	50.4–51.5	21.0	20.5–21.5	16.6	50.4-17.1	2,799	87.5	86.1–88.8	82.8	80.9–84.5	78.6	86.1-81.2
Occipital lobe (C71.4)	7,718	53.1	51.9–54.2	22.0	20.9–23.0	18.4	51.9-19.4	1,225	91.0	89.0–92.6	88.5	85.9–90.7	84.7	89.0-88.2
Ventricle, NOS (C71.5)	4,415	77.1	75.8–78.4	64.4	62.8–65.9	59.7	75.8-61.4	4948	93.9	93.2–94.6	91.0	89.9–92.0	87.2	93.2-88.8
Cerebellum, NOS (C71.6)	13,440	85.8	85.1–86.4	72.5	71.7–73.3	68.0	85.1-68.9	7,580	94.7	94.1–95.2	91.9	91.0–92.8	89.3	94.1-90.7
Brain stem (C71.7)	11,599	72.2	71.3–73.0	52.6	51.7–53.6	47.8	71.3-48.9	3,020	91.5	90.4–92.5	88.0	86.4–89.4	82.4	90.4-84.8
Other brain (C71.8-C71.9)	59,054	46.3	45.9–46.7	25.3	24.9–25.7	21.4	45.9-21.9	12,406	84.6	83.9–85.3	79.2	78.2–80.0	74.6	83.9-75.9
Spinal cord and cauda equina (C72.0-C72.1)	8,790	90.0	89.3–90.7	82.0	81.0–82.9	78.7	89.3-79.9	17,157	99.0	98.8–99.2	98.3	97.8–98.7	97.8	98.8-98.5
Cranial nerves (C72.2-C72.5)	3,674	97.1	96.5–97.6	93.4	92.4–94.3	92.4	96.5-93.5	54,180	99.4	99.3–99.5	99.4	99.3–99.5	99.4	99.3–99.5
Other nervous system (C72.8-C72.9)	2,613	63.8	61.9–65.7	49.3	47.1–51.5	44.4	61.9-47.0	2,417	97.4	96.5–98.1	94.5	92.9–95.7	92.1	96.5-94.2
Meninges (cerebral and spinal) (C70.0–9)	5,453	83.7	82.6–84.8	67.7	66.2–69.3	61.2	82.6-63.2	289,544	93.1	93.0–93.2	88.0	87.8–88.3	83.8	93.0-84.1
Pituitary and craniopharyngeal duct (C75.1-C75.2)	1,208	86.7	84.5–88.6	75.2	72.1–78.0	70.4	84.5-73.9	137,770	97.9	97.8–98.0	96.2	96.0–96.4	94.3	97.8-94.7
Pineal gland (C75.3)	2,513	89.2	87.9–90.4	75.9	73.9–77.7	71.5	87.9-73.6	1,388	94.3	92.8–95.5	90.2	87.8–92.0	86.5	92.8-89.6
Nasal cavity (C30.0)[d]	1,529	92.4	90.8–93.8	82.2	79.6–84.5	74.2	90.8-77.7	--	--	--	--	--	--	--
TOTAL	**277,275**	**60.1**	**59.9–60.3**	**35.8**	**35.6–36.0**	**30.8**	**59.9-31.0**	**548,756**	**94.9**	**94.8–95.0**	**91.5**	**91.4–91.7**	**88.7**	**94.8-88.9**

a. The cohort analysis of survival rates was utilized for calculating the survival estimates presented in this table. Long-term cohort-based survival estimates reflect the survival experience of individuals diagnosed over the time period, and they may not necessarily reflect the long-term survival outlook of newly diagnosed cases.
b. Rates are an estimate of the percentage of patients alive at one, five, and ten years, respectively.
c. Total number of case that occurred within the NPCR registries between 2001 and 2015.
d. ICD-O-3 histology codes 9522–9523 only.
- Rates were not presented for categories with 50 or fewer cases and were suppressed for rates where fewer than 16 cases were surviving within a category.
Abbreviations: CBTRUS, Central Brain Tumor Registry of the United States; NPCR, National Program of Cancer Registries; CI, Confidence Interval; NOS, Not otherwise specified

Table 21 One-, two-, five-, and ten-year relative survival rates[a,b] with 95% confidence intervals for selected malignant brain and other central nervous system tumors overall and by NCI age groups, U.S. Cancer Statistics – NPCR Registries, 2001–2015

Histology	Age-group (years)	N[c]	1-Year		2-Year		5-Year		10-Year	
			%	95% CI	%	95% CI	%	95% CI	%	95% CI
Pilocytic astrocytoma[d]	0-14[e]	8,009	98.8	98.5–99.0	98.3	98.0–98.6	97.0	96.6–97.4	95.7	95.0–96.2
	15-39[f]	4,105	98.2	97.8–98.6	97.2	96.6–97.7	94.6	93.8–95.3	92.8	91.7–93.7
	40+	1,370	91.3	89.5–92.8	86.0	83.8–87.9	78.0	75.2–80.5	76.4	73.2–79.3
	All Ages	13,484	97.9	97.6–98.1	96.7	96.4–97.0	94.4	93.9–94.8	92.9	92.3–93.4
Diffuse astrocytoma	0–14	2,347	92.3	91.1–93.3	86.8	85.4–88.2	83.0	81.3–84.5	80.8	78.9–82.5
	15–39	6,668	95.0	94.4–95.5	89.5	88.7–90.2	76.1	75.0–77.2	59.0	57.5–60.6
	40+	12,528	60.6	59.7–61.5	46.1	45.2–47.1	32.3	31.4–33.2	23.8	22.9–24.8
	All Ages	21,543	74.7	74.1–75.3	64.1	63.4–64.8	51.6	50.9–52.3	41.3	40.5–42.1
Anaplastic astrocytoma	0–14	676	65.4	61.6–68.9	36.3	32.5–40.1	25.2	21.7–28.9	20.4	16.9–24.2
	15–39	3,919	90.6	89.6–91.5	78.3	76.9–79.6	59.7	57.9–61.4	44.4	42.3–46.5
	40+	10,629	54.6	53.6–55.5	34.6	33.6–35.6	19.5	18.6–20.3	14.1	13.2–15.0
	All Ages	15,224	64.3	63.5–65.1	46.0	45.1–46.8	30.2	29.3–31.0	22.3	21.4–23.1
Unique astrocytoma variants	0–14	367	94.7	91.7–96.6	89.1	85.3–92.0	79.0	73.9–83.2	75.0	69.1–79.9
	15–39	671	94.8	92.8–96.3	90.3	87.7–92.4	79.2	75.5–82.5	75.0	70.8–78.7
	40+	655	59.5	55.4–63.3	44.6	40.5–48.6	30.3	26.3–34.5	25.4	20.9–30.1
	All Ages	1,693	81.2	79.2–83.0	72.5	70.2–74.7	60.5	57.8–63.1	56.2	53.3–59.1
Glioblastoma	0–14	1,136	58.1	55.2–61.0	33.0	30.2–35.9	21.8	19.2–24.5	18.1	15.6–20.8
	15–39	6,434	75.0	73.9–76.1	49.8	48.5–51.0	26.2	25.0–27.5	18.6	17.4–19.8
	40+	116,347	38.7	38.4–39.0	16.6	16.3–16.8	5.5	5.4–5.7	3.7	3.5–3.8
	All Ages	123,917	40.8	40.5–41.1	18.5	18.2–18.7	6.8	6.7–7.0	4.7	4.5–4.8
Oligodendroglioma	0–14	362	97.5	95.2–98.7	96.0	93.3–97.7	94.5	91.4–96.5	91.6	87.6–94.4
	15–39	4,373	98.6	98.2–98.9	97.2	96.7–97.7	91.4	90.4–92.3	76.2	74.4–77.9
	40+	6,013	91.3	90.5–92.0	85.4	84.4–86.3	75.5	74.2–76.8	61.6	59.9–63.3
	All Ages	10,748	94.5	94.0–94.9	90.6	90.0–91.2	82.7	81.9–83.5	68.7	67.5–69.9
Anaplastic oligodendroglioma	0–14	54	85.1	72.3–92.3	69.7	55.3–80.2	57.0	42.1–69.3	52.0	37.0–65.0
	15–39	1,353	95.0	93.6–96.0	88.6	86.7–90.2	75.2	72.5–77.6	60.3	56.9–63.5
	40+	3,311	82.0	80.6–83.3	68.5	66.7–70.1	53.9	52.0–55.8	41.6	39.3–43.9
	All Ages	4,718	85.8	84.7–86.8	74.3	73.0–75.6	60.2	58.6–61.7	47.3	45.4–49.2
Oligoastrocytic tumors	0–14	198	89.3	84.0–92.9	79.2	72.7–84.3	76.2	69.4–81.7	75.5	68.6–81.1
	15–39	3,232	97.3	96.7–97.8	93.5	92.5–94.3	80.0	78.4–81.5	59.5	57.2–61.8
	40+	3,869	81.8	80.5–83.0	68.6	67.0–70.1	53.3	51.5–55.0	41.0	38.9–43.1
	All Ages	7,299	88.9	88.1–89.6	80.0	79.0–80.9	65.9	64.6–67.0	50.3	48.7–51.8

Table 21 Continued

Histology	Age-group (years)	N[c]	1-Year		2-Year		5-Year		10-Year	
			%	95% CI	%	95% CI	%	95% CI	%	95% CI
Ependymal tumors	0–14	2,263	94.8	93.8–95.7	88.9	87.5–90.2	76.7	74.7–78.5	67.1	64.6–69.4
	15–39	2,863	97.1	96.4–97.7	95.1	94.2–95.9	91.7	90.5–92.7	87.5	85.8–89.0
	40+	5,149	92.9	92.1–93.6	90.2	89.3–91.1	86.4	85.1–87.5	82.8	81.0–84.4
	All Ages	10,275	94.5	94.0–95.0	91.3	90.7–91.9	85.7	84.9–86.5	80.6	79.5–81.7
Glioma malignant, NOS	0–14	6,008	81.1	80.1–82.1	70.7	69.5–71.8	67.6	66.4–68.9	66.4	65.1–67.7
	15–39	3,457	91.5	90.5–92.5	85.3	84.0–86.5	76.8	75.2–78.3	69.4	67.4–71.4
	40+	7,898	50.4	49.2–51.5	41.6	40.5–42.8	33.1	31.9–34.3	27.5	26.1–28.9
	All Ages	17,363	69.4	68.6–70.1	60.5	59.8–61.3	54.1	53.2–54.9	49.8	48.9–50.7
Choroid plexus tumors	0–14	248	85.5	80.3–89.5	77.2	71.2–82.2	64.0	57.0–70.2	58.6	50.9–65.6
	15–39	--	--	--	--	--	--	--	--	--
	40+	--	--	--	--	--	--	--	--	--
	All Ages	341	84.6	80.2–88.2	76.8	71.7–81.1	65.7	59.8–70.9	57.3	50.6–63.5
Other neuroepithelial tumors	0–14	--	--	--	--	--	--	--	--	--
	15–39	56	94.5	83.6–98.2	92.5	80.8–97.2	87.8	74.1–94.5	78.2	60.5–88.7
	40+	55	67.1	52.4–78.2	55.2	40.3–67.9	40.7	26.4–54.5	--	--
	All Ages	155	85.8	79.0–90.6	79.5	71.8–85.3	71.7	63.0–78.7	63.2	52.7–72.0
Neuronal and mixed neuronal-glial tumors	0–14	195	90.6	85.5–94.0	85.6	79.7–89.9	79.5	72.7–84.8	78.0	70.9–83.5
	15–39	511	94.6	92.2–96.3	87.2	83.8–89.9	78.9	74.7–82.5	71.4	66.1–76.1
	40+	1,394	90.4	88.6–92.0	84.9	82.7–86.9	77.4	74.5–80.1	69.4	65.3–73.2
	All Ages	2,100	91.5	90.1–92.7	85.5	83.8–87.1	78.0	75.8–80.0	71.0	68.0–73.8
Tumors of the pineal region	0–14	328	86.2	81.9–89.6	75.3	70.0–79.8	62.6	56.5–68.1	56.3	49.7–62.3
	15–39	341	92.0	88.5–94.5	85.9	81.4–89.3	71.9	66.0–77.0	64.2	57.0–70.5
	40+	286	85.3	80.3–89.1	78.3	72.5–82.9	67.3	60.4–73.3	57.4	48.8–65.1
	All Ages	955	88.0	85.7–90.0	79.9	77.0–82.4	67.3	63.8–70.6	59.7	55.5–63.6
Embryonal tumors	0–14	6,426	81.5	80.5–82.4	72.2	71.0–73.3	62.7	61.4–63.9	58.1	56.7–59.5
	15–39	2,340	90.1	88.8–91.2	82.5	80.8–84.0	69.6	67.5–71.6	59.7	57.2–62.0
	40+	860	69.5	66.2–72.6	55.9	52.4–59.3	46.5	42.8–50.2	36.4	32.2–40.7
	All Ages	9,626	82.5	81.7–83.3	73.3	72.3–74.2	62.9	61.9–64.0	56.6	55.4–57.7
Medulloblastoma	*0–14*	*3,975*	*89.5*	*88.4–90.4*	*82.1*	*80.8–83.3*	*72.3*	*70.8–73.8*	*66.8*	*65.0–68.5*
	15–39	*1,753*	*92.8*	*91.5–93.9*	*88.9*	*87.2–90.3*	*78.5*	*76.3–80.5*	*67.9*	*65.0–70.5*
	40+	*411*	*82.7*	*78.6–86.2*	*73.9*	*69.1–78.1*	*66.2*	*60.7–71.0*	*50.6*	*43.2–57.5*
	All Ages	*6,139*	*90.0*	*89.2–90.7*	*83.5*	*82.5–84.4*	*73.7*	*72.4–74.8*	*66.1*	*64.7–67.5*

Table 21 Continued

Histology	Age-group (years)	N[c]	1-Year		2-Year		5-Year		10-Year	
			%	95% CI	%	95% CI	%	95% CI	%	95% CI
Atypical Teratoid/Rhabdoid Tumor	*0–14*	*1,044*	*74.5*	*71.7–77.0*	*59.7*	*56.6–62.7*	*47.8*	*44.6–51.0*	*43.4*	*40.0–46.6*
	15–39	*447*	*83.2*	*79.3–86.3*	*63.3*	*58.5–67.7*	*41.5*	*36.5–46.3*	*34.2*	*29.2–39.1*
	40+	*331*	*56.0*	*50.3–61.2*	*36.4*	*31.0–41.8*	*24.6*	*19.7–29.9*	*19.5*	*14.8–24.8*
	All Ages	*1,822*	*73.3*	*71.2–75.3*	*56.4*	*54.0–58.7*	*42.1*	*39.7–44.5*	*37.0*	*34.6–39.5*
Primitive Neuroectodermal Tumors	*0–14*	*897*	*52.9*	*49.5–56.2*	*39.8*	*36.4–43.1*	*32.1*	*28.7–35.4*	*29.8*	*26.3–33.3*
	15–39	--	--	--	--	--	--	--	--	--
	40+	--	--	--	--	--	--	--	--	--
	All Ages	*945*	*53.4*	*50.1–56.6*	*40.4*	*37.1–43.7*	*32.4*	*29.2–35.7*	*30.0*	*26.6–33.4*
Nerve sheath tumors	0–14	--	--	--	--	--	--	--	--	--
	15–39	151	83.3	76.2–88.4	77.7	70.0–83.7	73.4	65.3–79.9	68.6	59.7–76.0
	40+	433	87.5	83.6–90.4	82.3	77.8–85.9	78.7	73.7–82.9	77.9	71.1–83.4
	All Ages	625	86.4	83.3–89.0	80.8	77.2–83.9	77.1	73.1–80.6	75.4	70.2–79.8
Meningioma	0–14	57	92.6	81.3–97.2	82.2	68.5–90.4	75.3	60.4–85.2	72.5	56.9–83.2
	15–39	385	94.2	91.3–96.2	91.2	87.7–93.7	84.1	79.6–87.6	78.4	72.9–82.9
	40+	4,250	83.4	82.1–84.6	77.1	75.6–78.5	66.6	64.8–68.4	60.0	57.5–62.3
	All Ages	4,692	84.4	83.2–85.5	78.4	77.0–79.7	68.2	66.5–69.9	61.7	59.5–63.8
Mesenchymal tumors	0–14	132	80.3	72.3–86.3	68.3	59.1–75.8	61.5	51.9–69.7	55.0	44.4–64.4
	15–39	257	89.6	85.0–92.8	84.4	79.1–88.5	74.0	67.6–79.4	63.5	55.5–70.4
	40+	574	83.4	79.9–86.4	76.8	72.7–80.2	62.1	57.1–66.6	48.3	42.1–54.3
	All Ages	963	84.7	82.1–86.9	77.6	74.7–80.3	65.3	61.6–68.6	53.5	49.0–57.7
Primary melanocytic lesions	0–14	--	--	--	--	--	--	--	--	--
	15–39	--	--	--	--	--	--	--	--	--
	40+	108	57.3	47.1–66.3	39.0	29.2–48.6	27.7	18.5–37.5	18.4	8.5–31.2
	All Ages	156	52.9	44.5–60.5	38.2	30.2–46.1	28.9	21.3–37.0	22.6	14.6–31.7
Lymphoma	0–14	80	89.8	80.7–94.8	83.2	72.8–89.9	78.9	67.7–86.5	73.2	60.7–82.2
	15–39	1,647	60.0	57.6–62.4	56.3	53.8–58.7	50.8	48.2–53.3	47.0	44.2–49.7
	40+	15,028	52.6	51.8–53.4	44.1	43.2–44.9	33.2	32.3–34.1	24.7	23.7–25.8
	All Ages	16,755	53.5	52.8–54.3	45.5	44.7–46.3	35.3	34.5–36.1	27.5	26.5–28.5
Other hematopoietic neoplasms	0–14	76	94.4	85.8–97.9	94.4	85.8–97.9	94.4	85.8–97.9	94.4	85.8–97.9
	15–39	71	92.8	83.5–97.0	86.7	75.7–92.9	76.5	61.6–86.3	76.5	61.6–86.3
	40+	273	76.8	71.0–81.5	66.0	59.6–71.7	54.1	47.0–60.6	52.4	45.1–59.1
	All Ages	420	82.6	78.5–86.1	74.4	69.6–78.6	64.5	58.9–69.6	63.2	57.3–68.5

Table 21 Continued

Histology	Age-group (years)	N[c]	1-Year		2-Year		5-Year		10-Year	
			%	95% CI	%	95% CI	%	95% CI	%	95% CI
Germ cell tumors, cysts, and heterotopias	0–14	1,208	92.8	91.2–94.2	90.2	88.3–91.8	87.0	84.8–88.9	83.9	81.2–86.2
	15–39	1,413	94.2	92.8–95.3	91.4	89.7–92.8	87.7	85.7–89.5	85.7	83.3–87.7
	40+	85	77.7	66.9–85.3	71.8	60.4–80.5	64.1	51.9–73.9	56.9	41.7–69.6
	All Ages	2,706	93.0	92.0–94.0	90.2	89.0–91.3	86.6	85.2–88.0	84.0	82.3–85.6
Tumors of the pituitary	0–14	--	--	--	--	--	--	--	--	--
	15–39	92	97.9	91.2–99.5	96.8	89.6–99.0	88.9	79.0–94.3	88.9	79.0–94.3
	40+	343	88.2	83.8–91.4	86.5	81.7–90.2	80.0	73.5–85.0	75.8	66.7–82.7
	All Ages	439	90.3	86.8–92.9	88.8	84.9–91.8	82.1	76.8–86.3	79.3	72.2–84.7
Neoplasm, unspecified	0–14	339	62.1	56.7–67.1	57.3	51.7–62.4	53.5	47.9–58.9	51.4	45.6–56.9
	15–39	768	76.3	73.0–79.2	72.0	68.6–75.1	65.2	61.5–68.6	60.0	55.9–63.9
	40+	8,931	26.8	25.8–27.7	21.7	20.8–22.6	16.8	15.9–17.8	14.9	13.9–15.9
	All Ages	10,038	31.9	31.0–32.9	26.9	26.0–27.9	22.0	21.1–23.0	19.9	18.9–20.9
TOTAL[g]	**0–14**	**30,711**	**87.4**	**87.0–87.7**	**80.2**	**79.7–80.6**	**74.7**	**74.2–75.2**	**71.6**	**71.0–72.1**
	15–39	**45,462**	**90.5**	**90.2–90.7**	**82.8**	**82.4–83.2**	**71.3**	**70.9–71.8**	**60.8**	**60.3–61.4**
	40+	**201,102**	**48.9**	**48.7–49.1**	**32.0**	**31.8–32.2**	**21.3**	**21.1–21.5**	**17.2**	**17.0–17.4**
	All Ages	**277,275**	**60.1**	**59.9–60.3**	**45.9**	**45.7–46.1**	**35.8**	**35.6–36.0**	**30.8**	**30.6–31.0**

a. The cohort analysis of survival rates was utilized for calculating the survival estimates presented in this table. Long-term cohort-based survival estimates reflect the survival experience of individuals diagnosed over a specific time period, and they may not necessarily reflect the long-term survival outlook of newly diagnosed cases.
b. Rates are estimates of the percentage of patients alive at one, two, five, and ten years, respectively.
c. Total number of cases that occurred within the NPCR registries between 2001 and 2015.
d. While pilocytic astrocytoma is listed as a tumor of uncertain behavior (/2), the cancer registry community historically codes this histology as a malignant tumor and as a result they are included in this table.
e. Children as defined by the National Cancer Institute, see: https://www.cancer.gov/research/areas/childhood.
f. Adolescents and Young Adults (AYA), as defined by the National Cancer Institute, see: https://www.cancer.gov/types/aya.
g. Total includes histologies not listed in this table.
- Rates were not presented for categories with 50 or fewer cases and were suppressed for rates where fewer than 16 cases were surviving within a category.
Abbreviations: CBTRUS, Central Brain Tumor Registry of the United States; NPCR, National Program of Cancer Registries; CI, Confidence Interval; NOS, Not otherwise specified

Table 22 One-, two-, five-, and ten-year relative survival rates[a,b] with 95% confidence intervals for selected malignant brain and other central nervous system tumors by selected age-groups, U.S. Cancer Statistics – NPCR Registries, 2001–2015

Histology	Age- group (years)	N[c]	1-Year		2-Year		5-Year		10-Year	
			%	95% CI	%	95% CI	%	95% CI	%	95% CI
Pilocytic astrocytoma[d]	0–19	9,749	98.8	98.6–99.0	98.3	98.0–98.6	96.9	96.5–97.3	95.7	95.2–96.2
	20–44	2,684	97.1	96.4–97.7	95.5	94.5–96.2	92.3	91.1–93.3	89.5	88.0–90.9
	45–54	498	94.6	92.1–96.3	88.8	85.4–91.4	80.4	76.0–84.1	77.5	72.1–82.1
	55–64	301	91.1	87.0–94.0	85.0	80.0–88.9	74.0	67.5–79.4	73.6	65.2–80.3
	65–74	164	82.1	74.8–87.4	76.5	68.3–82.9	68.3	58.2–76.5	63.4	51.9–72.9
	75+	88	83.0	71.3–90.2	76.2	62.8–85.4	67.0	50.8–78.9	67.0	50.8–78.9
Diffuse astrocytoma	0–19	3,128	93.0	92.0–93.9	87.3	86.0–88.5	82.8	81.3–84.1	79.9	78.3–81.4
	20–44	7,551	94.0	93.4–94.5	87.9	87.1–88.6	73.1	72.0–74.2	55.0	53.5–56.5
	45–54	3,366	78.8	77.4–80.2	64.4	62.7–66.0	46.3	44.4–48.1	35.1	33.0–37.2
	55–64	3,104	61.0	59.2–62.7	42.1	40.3–43.9	26.1	24.4–27.9	18.4	16.6–20.4
	65–74	2,442	43.6	41.5–45.6	26.5	24.7–28.4	15.5	13.9–17.3	10.3	8.5–12.2
	75+	1,952	22.0	20.1–24.0	12.7	11.1–14.3	7.7	6.3–9.4	5.3	3.5–7.7
Anaplastic astrocytoma	0–19	951	70.1	67.0–72.9	41.8	38.5–45.1	27.8	24.7–30.9	22.9	19.8–26.2
	20–44	4,890	89.6	88.7–90.4	77.0	75.7–78.2	57.9	56.3–59.5	43.0	41.1–44.8
	45–54	2,683	73.1	71.3–74.8	50.0	48.0–52.0	29.1	27.1–31.0	22.1	20.1–24.1
	55–64	2,881	55.9	54.0–57.8	32.4	30.6–34.2	15.3	13.8–16.9	9.8	8.3–11.5
	65–74	2,290	37.5	35.4–39.5	17.7	16.0–19.4	7.7	6.4–9.1	4.8	3.5–6.4
	75+	1,529	18.9	16.9–21.0	7.6	6.2–9.1	2.9	1.9–4.3	1.9	1.0–3.3
Unique astrocytoma variants	0–19	596	95.7	93.7–97.1	90.4	87.6–92.6	80.6	76.8–83.8	76.5	72.1–80.3
	20–44	529	92.3	89.6–94.3	86.6	83.2–89.3	74.5	69.9–78.4	70.7	65.7–75.2
	45–54	163	77.2	69.8–83.0	55.5	47.2–63.0	39.4	31.2–47.5	31.4	22.6–40.6
	55–64	155	62.7	54.4–70.0	44.3	36.0–52.4	29.1	21.3–37.4	21.4	13.3–30.6
	65–74	126	36.5	27.9–45.1	27.1	19.1–35.7	--	--	--	--
	75+	124	34.4	25.6–43.4	26.3	17.8–35.5	--	--	--	--
Glioblastoma	0–19	1,659	62.5	60.0–64.8	36.1	33.7–38.6	20.8	18.7–23.0	16.6	14.5–18.8
	20–44	10,448	71.8	70.9–72.7	43.6	42.6–44.6	21.9	21.0–22.8	15.2	14.3–16.1
	45–54	20,730	58.6	57.9–59.2	27.1	26.4–27.7	9.3	8.9–9.8	5.7	5.3–6.2
	55–64	34,309	47.4	46.9–48.0	19.9	19.4–20.3	5.9	5.6–6.2	3.5	3.2–3.8
	65–74	31,664	31.2	30.7–31.7	12.1	11.7–12.5	3.9	3.6–4.1	3.0	2.7–3.3
	75+	25,107	13.4	12.9–13.8	4.8	4.5–5.2	1.9	1.7–2.2	1.9	1.7–2.2

Table 22 Continued

Histology	Age- group (years)	N[c]	1-Year		2-Year		5-Year		10-Year	
			%	95% CI	%	95% CI	%	95% CI	%	95% CI
Oligodendroglioma	0–19	646	98.0	96.5–98.8	96.7	94.9–97.8	94.8	92.6–96.3	89.7	86.4–92.3
	20–44	5,552	98.3	97.9–98.7	96.5	96.0–97.0	90.1	89.1–90.9	75.1	73.5–76.6
	45–54	2,324	95.3	94.3–96.1	91.3	90.0–92.5	82.0	80.2–83.8	68.0	65.3–70.6
	55–64	1,370	89.9	88.1–91.5	80.4	78.0–82.5	69.4	66.5–72.2	54.4	50.4–58.2
	65–74	579	78.5	74.7–81.8	68.5	64.2–72.5	52.3	47.2–57.2	35.7	29.2–42.3
	75+	277	56.0	49.5–62.1	43.7	37.0–50.1	31.9	24.7–39.2	14.7	8.5–22.6
Anaplastic oligodendroglioma	0–19	115	85.1	77.1–90.5	65.8	56.1–73.8	49.5	39.5–58.7	39.7	29.8–49.4
	20–44	1,855	95.4	94.3–96.3	88.9	87.3–90.3	75.8	73.5–77.8	61.6	58.7–64.4
	45–54	1,140	91.2	89.3–92.8	80.4	77.9–82.8	66.6	63.4–69.7	50.0	45.9–53.9
	55–64	937	79.9	77.0–82.4	62.0	58.6–65.2	45.0	41.3–48.6	34.7	30.3–39.0
	65–74	456	63.9	59.1–68.3	47.1	42.0–52.0	30.3	25.2–35.5	21.1	15.5–27.3
	75+	215	43.4	36.3–50.3	26.8	20.5–33.5	17.4	11.4–24.5	13.1	6.0–23.0
Oligoastrocytic tumors	0–19	355	92.0	88.7–94.5	84.3	80.0–87.8	78.4	73.4–82.5	71.2	65.4–76.2
	20–44	3,935	96.9	96.3–97.4	92.4	91.5–93.3	78.7	77.2–80.0	59.3	57.1–61.3
	45–54	1,361	90.2	88.5–91.7	80.4	78.1–82.5	64.7	61.8–67.4	48.5	44.8–52.2
	55–64	965	78.3	75.5–80.9	57.3	54.0–60.5	39.7	36.2–43.1	31.8	27.9–35.8
	65–74	475	61.4	56.7–65.8	42.1	37.4–46.8	26.0	21.5–30.8	15.6	10.6–21.5
	75+	208	30.5	24.1–37.1	18.2	12.9–24.3	10.1	5.7–16.1	--	--
Ependymal tumors	0–19	2,734	95.2	94.3–96.0	89.8	88.5–90.9	78.9	77.1–80.5	69.9	67.7–72.0
	20–44	3,231	97.1	96.4–97.6	95.2	94.3–95.9	91.9	90.7–92.9	88.7	87.2–90.1
	45–54	1,835	95.8	94.7–96.7	93.5	92.2–94.7	89.5	87.7–91.0	86.1	83.6–88.3
	55–64	1,353	92.5	90.8–93.8	90.4	88.5–92.0	87.3	84.8–89.3	84.5	80.9–87.5
	65–74	785	88.6	85.9–90.9	82.7	79.3–85.5	77.9	73.6–81.6	69.0	61.9–75.0
	75+	337	77.8	72.3–82.4	76.7	70.4–81.8	72.8	63.7–80.0	61.5	47.2–73.0
Glioma malignant, NOS	0–19	6,852	82.5	81.5–83.4	72.4	71.3–73.5	69.3	68.2–70.5	68.0	66.8–69.2
	20–44	3,344	90.0	88.9–91.0	83.4	82.0–84.6	73.2	71.5–74.8	64.0	61.8–66.1
	45–54	1,621	77.1	74.9–79.1	66.2	63.8–68.6	55.9	53.2–58.6	48.0	44.8–51.1
	55–64	1,522	62.3	59.7–64.7	50.5	47.9–53.1	37.6	34.8–40.4	29.1	25.9–32.4
	65–74	1,464	41.9	39.3–44.5	31.4	28.9–33.9	23.1	20.6–25.7	18.7	15.6–22.0
	75+	2,560	19.1	17.5–20.7	14.6	13.1–16.1	10.2	8.6–11.8	7.9	5.9–10.1

Table 22 Continued

Histology	Age- group (years)	N[c]	1-Year		2-Year		5-Year		10-Year	
			%	95% CI	%	95% CI	%	95% CI	%	95% CI
Neuronal and mixed neuronal-glial tumors	0–19	282	91.7	87.7–94.4	84.3	79.3–88.2	78.3	72.7–82.9	76.8	70.9–81.6
	20–44	598	95.1	93.0–96.6	90.2	87.4–92.4	82.6	78.8–85.7	74.3	69.4–78.6
	45–54	419	94.8	92.0–96.6	89.5	85.8–92.2	83.3	78.6–87.0	79.4	73.1–84.3
	55–64	391	90.0	86.3–92.7	81.6	77.0–85.4	72.3	66.5–77.2	64.4	56.6–71.2
	65–74	245	89.3	84.0–92.9	86.2	80.1–90.6	79.4	70.9–85.6	66.1	54.0–75.8
	75+	165	75.1	66.6–81.7	68.1	58.5–76.0	56.6	44.3–67.3	34.8	18.0–52.2
Tumors of the pineal region	0–19	422	87.2	83.5–90.1	78.0	73.5–81.8	64.3	59.0–69.1	57.2	51.3–62.6
	20–44	290	92.9	89.2–95.4	85.9	81.0–89.6	74.9	68.6–80.1	68.7	61.0–75.2
	45–54	116	86.6	78.6–91.8	77.0	67.5–84.0	70.4	59.6–78.8	60.1	47.3–70.8
	55–64	81	85.1	74.5–91.5	81.4	70.0–88.8	64.6	50.2–75.8	47.6	28.7–64.3
	65–74	--	--	--	--	--	--	--	--	--
	75+	--	--	--	--	--	--	--	--	--
Embryonal tumors	0–19	7,089	82.5	81.6–83.4	73.4	72.3–74.4	63.6	62.4–64.8	58.5	57.1–59.8
	20–44	1,899	88.8	87.3–90.2	80.9	79.0–82.7	68.3	66.0–70.6	58.3	55.6–61.0
	45–54	308	75.6	70.3–80.1	61.0	55.1–66.4	51.3	45.0–57.2	40.1	32.8–47.2
	55–64	188	62.1	54.5–68.8	48.5	40.8–55.8	35.8	28.1–43.5	23.7	16.1–32.3
	65–74	78	45.3	33.6–56.2	23.1	13.9–33.7	--	--	--	--
	75+	64	28.9	17.9–40.9	--	--	--	--	--	--
Nerve sheath tumors	0–19	58	89.4	77.9–95.1	81.9	68.9–89.9	80.0	66.6–88.4	77.3	62.9–86.7
	20–44	180	84.3	78.0–88.9	78.4	71.5–83.9	73.6	66.1–79.6	70.7	62.7–77.3
	45–54	139	90.1	83.5–94.1	85.0	77.5–90.2	82.1	74.1–87.9	81.2	71.4–88.0
	55–64	105	84.1	75.2–90.0	78.6	68.8–85.6	75.1	64.2–83.1	73.1	59.5–82.7
	65–74	86	94.6	84.7–98.2	91.2	79.5–96.3	85.7	69.1–93.7	83.8	63.2–93.5
	75+	57	73.1	57.5–83.7	65.2	48.2–77.7	58.6	39.4–73.6	58.6	39.4–73.6
Meningioma	0–19	89	91.8	83.5–96.0	84.0	74.0–90.5	79.7	68.8–87.1	78.0	66.6–85.9
	20–44	600	94.0	91.7–95.7	91.7	89.0–93.7	84.0	80.5–86.9	76.8	72.5–80.6
	45–54	747	91.7	89.3–93.5	86.1	83.2–88.5	79.4	75.9–82.4	74.9	70.7–78.5
	55–64	991	89.7	87.5–91.5	84.2	81.6–86.5	73.8	70.4–76.8	65.3	61.0–69.3
	65–74	1,036	84.5	82.0–86.8	77.7	74.7–80.4	63.3	59.4–66.9	57.9	53.0–62.4
	75+	1,229	69.5	66.5–72.3	61.3	57.9–64.6	50.2	45.9–54.4	39.5	32.8–46.0

Table 22 Continued

Histology	Age- group (years)	N[c]	1-Year		2-Year		5-Year		10-Year	
			%	95% CI	%	95% CI	%	95% CI	%	95% CI
Mesenchymal tumors	0–19	169	82.4	75.6–87.4	71.2	63.5–77.6	61.2	52.8–68.6	54.1	44.9–62.5
	20–44	301	88.0	83.7–91.3	84.0	79.2–87.9	74.5	68.6–79.5	61.1	53.6–67.9
	45–54	179	90.7	85.1–94.2	83.7	77.1–88.6	75.5	67.4–81.8	63.6	53.6–72.0
	55–64	154	85.3	78.4–90.2	77.2	69.1–83.4	58.5	48.3–67.4	47.7	35.0–59.4
	65–74	97	82.0	71.9–88.7	76.2	64.9–84.2	49.7	35.8–62.1	24.5	8.6–44.6
	75+	63	58.8	44.6–70.6	49.5	34.8–62.6	30.4	16.5–45.4	--	--
Other neoplasms related to the meninges	0–19	62	95.0	85.3–98.4	89.7	78.5–95.3	85.5	72.8–92.6	77.9	62.9–87.4
	20–44	224	96.0	92.3–98.0	91.7	86.9–94.8	86.5	80.5–90.8	76.7	68.0–83.2
	45–54	125	95.3	89.2–98.0	93.9	87.0–97.2	87.7	78.5–93.1	76.8	63.9–85.5
	55–64	116	90.3	82.8–94.7	84.6	75.8–90.4	67.0	55.9–76.0	41.5	27.8–54.7
	65–74	103	95.0	86.2–98.2	90.4	80.1–95.5	84.4	70.5–92.1	58.5	40.0–73.2
	75+	74	85.0	71.5–92.4	79.1	63.2–88.7	61.3	41.3–76.3	48.4	28.8–65.5
Lymphoma	0–19	164	86.1	79.7–90.7	80.6	73.4–86.1	76.0	68.2–82.2	72.1	63.6–79.0
	20–44	2,413	57.1	55.1–59.1	52.6	50.5–54.6	45.9	43.8–48.0	41.0	38.7–43.2
	45–54	2,488	64.6	62.6–66.5	56.8	54.7–58.8	46.3	44.1–48.4	35.8	33.4–38.2
	55–64	3,688	63.4	61.8–65.0	54.7	53.0–56.4	42.1	40.3–44.0	30.6	28.4–32.8
	65–74	4,348	52.6	51.1–54.2	43.1	41.5–44.7	30.1	28.5–31.8	21.5	19.5–23.6
	75+	3,654	32.4	30.8–34.0	23.9	22.4–25.5	15.8	14.3–17.5	11.3	9.1–13.7
Other hematopoietic neoplasms	0–19	92	92.0	83.9–96.1	92.0	83.9–96.1	90.2	81.0–95.1	90.2	81.0–95.1
	20–44	89	88.7	79.8–93.8	81.5	71.3–88.3	74.4	62.3–83.2	72.4	59.6–81.7
	45–54	65	86.3	74.9–92.8	75.3	62.4–84.3	67.2	53.2–77.9	60.5	44.1–73.5
	55–64	74	85.3	74.3–91.9	72.3	59.5–81.6	62.1	48.1–73.4	62.1	48.1–73.4
	65–74	63	64.5	50.9–75.2	54.0	40.2–65.9	40.9	26.9–54.5	36.5	22.4–50.8
	75+	--	--	--	--	--	--	--	--	--
Tumors of the pituitary	0–19	--	--	--	--	--	--	--	--	--
	20–44	134	95.6	90.2–98.0	94.2	88.2–97.2	89.1	81.5–93.7	88.3	80.0–93.3
	45–54	86	89.6	80.4–94.6	88.7	79.1–94.0	78.6	66.2–86.9	73.1	58.8–83.2
	55–64	82	86.9	76.7–92.8	83.4	72.2–90.4	79.8	66.6–88.2	79.8	66.6–88.2
	65–74	72	88.9	77.6–94.7	88.9	77.6–94.7	78.8	63.2–88.4	68.7	41.4–85.2
	75+	52	82.3	65.6–91.5	79.5	59.6–90.3	68.9	42.6–85.0	52.9	27.4–73.0

Table 22 Continued

Histology	Age- group (years)	N[c]	1-Year		2-Year		5-Year		10-Year	
			%	95% CI	%	95% CI	%	95% CI	%	95% CI
Neoplasm, unspecified	0–19	435	66.6	61.9–70.9	61.8	56.9–66.2	58.5	53.5–63.1	55.8	50.5–60.8
	20–44	955	71.9	68.9–74.7	66.9	63.7–69.8	59.4	56.0–62.6	55.1	51.4–58.6
	45–54	809	59.3	55.8–62.7	51.8	48.2–55.3	44.2	40.5–47.8	39.0	35.0–42.9
	55–64	1,188	42.2	39.3–45.0	34.1	31.3–36.9	27.5	24.8–30.3	24.4	21.4–27.4
	65–74	1,567	27.8	25.6–30.1	22.4	20.3–24.6	16.4	14.4–18.6	15.0	12.8–17.3
	75+	5,084	14.6	13.6–15.7	10.8	9.9–11.8	7.3	6.3–8.3	5.7	4.6–6.9
TOTAL[e]	**0–19**	**37,967**	**88.5**	**88.1–88.8**	**81.3**	**80.9–81.8**	**75.5**	**75.1–76.0**	**72.2**	**71.7–72.7**
	20–44	**52,662**	**87.6**	**87.3–87.9**	**77.8**	**77.4–78.1**	**65.1**	**64.6–65.5**	**54.2**	**53.6–54.7**
	45–54	**41,351**	**70.1**	**69.7–70.5**	**49.2**	**48.7–49.8**	**34.5**	**34.0–35.0**	**27.9**	**27.4–28.5**
	55–64	**54,095**	**55.3**	**54.8–55.7**	**33.1**	**32.7–33.5**	**19.8**	**19.4–20.1**	**15.3**	**14.9–15.8**
	65–74	**48,251**	**38.6**	**38.1–39.0**	**22.1**	**21.7–22.5**	**13.1**	**12.7–13.5**	**10.4**	**9.9–10.8**
	75+	**42,949**	**19.6**	**19.2–20.0**	**11.8**	**11.5–12.2**	**7.7**	**7.3–8.0**	**6.4**	**6.0–6.9**

a. The cohort analysis of survival rates was utilized for calculating the survival estimates presented in this table. Long-term cohort-based survival estimates reflect the survival experience of individuals diagnosed over the time period, and they may not necessarily reflect the long-term survival outlook of newly diagnosed cases.
b. Rates are an estimate of the percentage of patients alive at one, two, five, and ten years, respectively.
c. Total number of case that occurred within the NPCR registries between 2001 and 2015.
d. While pilocytic astrocytoma is coded as a tumor of uncertain behavior (/2), the cancer registry community historically codes this histology as a malignant tumor and as a result they are included in this table.
e. Total includes histologies not listed in this table.
- Rates were not presented for categories with 50 or fewer cases and were suppressed for rates where fewer than 16 cases were surviving within a category.
Abbreviations: CBTRUS, Central Brain Tumor Registry of the United States; NPCR, National Program of Cancer Registries; CI, Confidence Interval; NOS, Not otherwise specified

Table 23 One-, two-, five-, and ten-year relative survival rates[a,b] with 95% confidence intervals for selected non-malignant brain and other central nervous system tumors by NCI age-groups, U.S. Cancer Statistics – NPCR Registries, 2004–2015

Histology	Age-group (years)	N[c]	1-Year		2-Year		5-Year		10-Year	
			%	95% CI	%	95% CI	%	95% CI	%	95% CI
Unique astrocytoma variants	0-14[d]	517	98.5	96.9–99.3	97.9	96.1–98.8	97.3	95.3–98.5	94.9	90.1–97.4
	15-39[e]	274	97.1	94.1–98.5	96.3	93.1–98.1	93.7	89.6–96.3	89.1	82.0–93.6
	40+	64	94.0	83.3–97.9	87.0	74.3–93.7	83.7	69.2–91.7	65.7	40.4–82.3
	All Ages	855	97.7	96.4–98.5	96.6	95.1–97.7	95.3	93.4–96.6	91.1	87.3–93.8
Ependymal tumors	0–14	229	99.1	96.3–99.8	98.7	95.7–99.6	96.8	92.7–98.6	96.0	91.3–98.2
	15–39	1,879	99.5	98.9–99.7	99.3	98.7–99.7	98.7	97.8–99.3	97.5	95.7–98.6
	40+	3,761	96.6	95.8–97.2	96.2	95.3–96.9	95.8	94.5–96.8	93.3	90.7–95.3
	All Ages	5,869	97.6	97.1–98.0	97.3	96.7–97.8	96.8	95.9–97.5	94.8	93.2–96.1
Choroid plexus tumors	0–14	586	98.3	96.6–99.1	97.9	96.2–98.8	97.0	95.0–98.2	96.7	94.6–98.0
	15–39	446	98.2	96.3–99.1	97.8	95.7–98.9	97.0	94.6–98.3	93.0	87.4–96.2
	40+	517	88.8	85.5–91.4	88.2	84.6–91.0	84.1	79.4–87.8	79.4	71.5–85.3
	All Ages	1,549	95.1	93.8–96.1	94.6	93.2–95.8	92.8	91.0–94.3	90.1	87.2–92.3
Neuronal and mixed neuronal-glial tumors	0–14	2,329	99.2	98.7–99.5	98.3	97.6–98.8	96.9	96.0–97.6	95.8	94.4–96.8
	15–39	3,527	98.8	98.3–99.1	98.4	97.9–98.8	97.3	96.6–97.9	95.1	93.7–96.2
	40+	1,991	94.8	93.6–95.8	92.5	91.1–93.8	89.1	87.1–90.8	86.5	83.2–89.2
	All Ages	7,847	97.9	97.5–98.2	96.9	96.4–97.3	95.2	94.5–95.7	93.2	92.1–94.1
Tumors of the pineal region	0–14	--	--	--	--	--	--	--	--	--
	15–39	285	97.5	94.7–98.8	97.2	94.2–98.6	96.8	93.4–98.5	96.2	91.8–98.2
	40+	363	92.7	89.2–95.2	91.0	86.8–93.9	86.6	80.7–90.8	79.4	68.1–87.1
	All Ages	697	95.1	93.0–96.5	94.0	91.6–95.7	91.8	88.5–94.1	87.7	81.7–91.9
Embryonal tumors	0–14	53	100.0	**	100.0	**	100.0	**	95.4	69.7–99.4
	15–39	85	100.0	**	100.0	**	100.0	**	96.3	63.5–99.7
	40+	106	96.1	88.7–98.7	96.1	88.7–98.7	95.4	82.8–98.8	86.8	69.3–94.7
	All Ages	244	98.3	95.0–99.5	98.3	95.0–99.5	98.1	91.6–99.6	91.7	82.0–96.3
Nerve sheath tumors	0–14	1,942	99.9	99.2–100.0	99.7	99.2–99.9	99.0	98.3–99.4	98.2	97.0–98.8
	15–39	10,679	99.4	99.3–99.6	99.2	99.0–99.4	98.6	98.3–98.9	97.7	97.1–98.2
	40+	56,346	99.3	99.1–99.4	99.3	99.1–99.4	99.3	99.1–99.4	99.3	99.1–99.4
	All Ages	68,967	99.3	99.2–99.4	99.3	99.2–99.4	99.3	99.2–99.4	99.3	99.2–99.4

Table 23 Continued

Histology	Age-group (years)	N[c]	1-Year		2-Year		5-Year		10-Year	
			%	95% CI	%	95% CI	%	95% CI	%	95% CI
Meningioma	0–14	534	98.3	96.7–99.1	97.5	95.6–98.5	95.7	93.3–97.3	89.9	84.9–93.3
	15–39	18,574	98.8	98.6–98.9	98.2	98.0–98.4	97.0	96.7–97.3	94.8	94.2–95.3
	40+	271,578	92.7	92.5–92.8	90.9	90.7–91.0	87.3	87.1–87.6	82.8	82.4–83.2
	All Ages	290,686	93.1	93.0–93.2	91.4	91.2–91.5	88.0	87.8–88.2	83.7	83.3–84.0
Mesenchymal tumors	0–14	518	99.8	96.4–100.0	98.6	96.8–99.4	97.6	95.2–98.8	96.5	93.4–98.2
	15–39	571	98.8	97.4–99.5	98.7	97.2–99.4	97.5	95.2–98.7	94.8	90.2–97.3
	40+	1,364	95.1	93.5–96.2	94.2	92.4–95.6	89.2	86.5–91.4	81.3	76.2–85.4
	All Ages	2,453	97.0	96.0–97.7	96.2	95.1–97.0	92.9	91.2–94.2	87.4	84.2–90.0
Primary melanocytic lesions	0–14	--	--	--	--	--	--	--	--	--
	15–39	--	--	--	--	--	--	--	--	--
	40+	60	80.3	66.8–88.8	71.7	56.8–82.2	55.7	38.0–70.1	41.2	21.3–60.2
	All Ages	82	84.6	74.1–91.1	78.7	67.0–86.7	63.3	49.2–74.4	52.8	37.0–66.3
Other neoplasms related to the meninges	0–14	100	98.0	92.0–99.5	96.9	90.4–99.0	94.1	86.1–97.6	84.3	66.0–93.2
	15–39	1,858	98.3	97.6–98.8	97.7	96.9–98.4	96.7	95.5–97.5	93.7	91.6–95.3
	40+	3,930	95.2	94.4–96.0	94.5	93.5–95.3	92.7	91.3–93.9	88.7	86.0–90.9
	All Ages	5,888	96.3	95.7–96.8	95.5	94.9–96.2	94.0	93.0–94.8	90.2	88.4–91.8
Germ cell tumors, cysts, and heterotopias	0–14	356	96.9	94.4–98.3	96.6	94.0–98.1	96.6	94.0–98.1	96.2	93.1–97.9
	15–39	365	99.5	97.5–99.9	98.4	96.1–99.3	96.8	93.7–98.4	95.5	89.8–98.0
	40+	415	94.9	91.8–96.8	93.8	90.1–96.1	91.8	86.5–95.0	83.7	73.8–90.1
	All Ages	1,136	97.0	95.7–98.0	96.2	94.6–97.3	94.9	92.8–96.4	91.6	87.8–94.2
Tumors of the pituitary	0–14	1,750	99.9	99.5–100.0	99.7	99.2–99.9	99.4	98.7–99.8	98.8	97.8–99.4
	15–39	38,856	99.7	99.6–99.7	99.6	99.5–99.6	99.3	99.1–99.4	98.7	98.4–98.9
	40+	88,937	97.4	97.3–97.5	96.9	96.7–97.1	95.6	95.3–95.9	93.3	92.7–93.9
	All Ages	129,543	98.1	98.0–98.2	97.7	97.6–97.9	96.8	96.6–97.0	95.1	94.7–95.5
Craniopharyngioma	0–14	1,519	98.7	97.9–99.1	97.9	97.0–98.5	95.2	93.8–96.3	92.8	90.8–94.4
	15–39	1,595	95.9	94.8–96.8	94.5	93.2–95.5	91.3	89.6–92.8	88.0	85.7–90.0
	40+	3,462	89.4	88.2–90.5	86.2	84.8–87.4	79.4	77.6–81.1	72.7	69.8–75.2
	All Ages	6,576	93.1	92.5–93.8	90.9	90.1–91.7	86.1	85.0–87.1	81.4	79.8–82.9
Hemangioma	0–14	616	99.0	97.7–99.6	98.5	97.0–99.2	97.8	96.0–98.8	97.8	96.0–98.8
	15–39	2,885	99.5	99.1–99.7	99.3	98.8–99.6	98.8	98.1–99.3	96.8	95.1–98.0
	40+	6,830	95.4	94.8–96.0	94.1	93.3–94.8	91.6	90.4–92.6	88.4	85.9–90.5
	All Ages	10,331	96.8	96.4–97.2	95.8	95.3–96.3	94.0	93.3–94.7	91.5	89.9–92.9

Table 23 Continued

Histology	Age-group (years)	N[c]	1-Year		2-Year		5-Year		10-Year	
			%	95% CI	%	95% CI	%	95% CI	%	95% CI
Neoplasm, unspecified	0–14	888	94.7	93.0–96.1	94.2	92.4–95.6	93.8	91.9–95.3	92.4	89.7–94.3
	15–39	2,943	95.7	94.8–96.4	94.8	93.9–95.6	93.5	92.5–94.5	91.9	90.4–93.2
	40+	11,065	69.5	68.6–70.5	65.9	64.9–66.8	60.4	59.2–61.6	53.2	51.5–54.9
	All Ages	14,896	76.3	75.6–77.1	73.4	72.6–74.2	69.2	68.3–70.2	63.8	62.5–65.1
TOTAL[f]	**0–14**	**12,233**	**98.8**	**98.6–99.0**	**98.2**	**98.0–98.5**	**97.2**	**96.8–97.5**	**95.8**	**95.2–96.2**
	15–39	**85,129**	**99.1**	**99.0–99.2**	**98.8**	**98.7–98.9**	**98.1**	**98.0–98.2**	**96.7**	**96.5–97.0**
	40+	**451,394**	**93.9**	**93.9–94.0**	**92.6**	**92.5–92.7**	**90.1**	**89.9–90.2**	**86.8**	**86.5–87.1**
	All Ages	**548,756**	**94.9**	**94.8–95.0**	**93.7**	**93.6–93.8**	**91.5**	**91.4–91.7**	**88.7**	**88.5–88.9**

a. The cohort analysis of survival rates was utilized for calculating the survival estimates presented in this table. Long-term cohort-based survival estimates reflect the survival experience of individuals diagnosed over the time period, and they may not necessarily reflect the long-term survival outlook of newly diagnosed cases.
b. Rates are an estimate of the percentage of patients alive at one, two, five, and ten years, respectively.
c. Total number of case that occurred within the NPCR registries between 2004 and 2015.
d. Children as defined by the National Cancer Institute, see: https://www.cancer.gov/research/areas/childhood.
e. Adolescents and Young Adults (AYA), as defined by the National Cancer Institute, see: https://www.cancer.gov/types/aya.
f. Total includes histologies not listed in this table.
- Rates were not presented for categories with 50 or fewer cases and were suppressed for rates where fewer than 16 cases were surviving within a category.
*** Confidence interval could not be calculated.*
Abbreviations: CBTRUS, Central Brain Tumor Registry of the United States; NPCR, National Program of Cancer Registries; CI, Confidence Interval; NOS, Not otherwise specified

Table 24 Brain and other central nervous system one-, two-, five-, and ten-year relative survival rates[a,b] with 95% confidence intervals for selected non-malignant brain and other central nervous system tumors by selected age-groups, U.S. Cancer Statistics – NPCR Registries, 2004–2015

Histology	Age group (year)	N[c]	1-Year		2-Year		5-Year		10-Year	
			%	95% CI	%	95% CI	%	95% CI	%	95% CI
Unique astrocytoma variants	0–19	617	98.7	97.4–99.4	97.9	96.3–98.8	97.0	95.2–98.2	94.7	90.5–97.1
	20–44	193	95.3	91.0–97.6	95.3	91.0–97.6	92.5	87.0–95.7	87.3	78.2–92.8
	45–54	--	--	--	--	--	--	--	--	--
	55–64	--	--	--	--	--	--	--	--	--
	65–74	--	--	--	--	--	--	--	--	--
	75+	--	--	--	--	--	--	--	--	--
Ependymal tumors	0–19	426	99.6	98.0–99.9	99.3	97.6–99.8	98.5	96.2–99.4	97.5	93.8–99.0
	20–44	2,223	99.2	98.7–99.6	99.1	98.5–99.5	98.6	97.7–99.1	97.3	95.5–98.4
	45–54	1,300	98.5	97.5–99.1	98.4	97.2–99.1	98.0	96.6–98.8	97.1	93.2–98.8
	55–64	1,007	96.7	95.1–97.8	96.2	94.3–97.4	94.0	91.2–96.0	92.3	86.6–95.6
	65–74	634	93.5	90.9–95.5	91.8	88.6–94.2	91.8	88.6–94.2	84.9	72.9–91.9
	75+	279	89.5	83.7–93.3	89.5	83.7–93.3	89.2	78.2–94.9	81.1	59.6–91.9
Choroid plexus tumors	0–19	689	98.4	97.0–99.1	98.1	96.6–98.9	97.3	95.6–98.4	96.8	94.8–98.1
	20–44	424	97.9	95.8–98.9	97.2	94.8–98.5	95.9	93.0–97.7	92.2	86.4–95.6
	45–54	166	94.8	89.7–97.4	94.5	89.0–97.2	90.1	82.8–94.4	83.1	70.3–90.7
	55–64	127	86.7	79.0–91.7	86.5	78.4–91.7	83.9	74.0–90.3	76.4	62.7–85.6
	65–74	81	81.1	70.0–88.5	79.8	67.8–87.7	72.9	57.0–83.7	64.5	37.5–82.3
	75+	62	75.5	60.8–85.3	74.6	57.9–85.5	68.4	49.8–81.2	--	--
Neuronal and mixed neuronal-glial tumors	0–19	3,453	99.3	98.9–99.5	98.5	98.0–98.9	97.4	96.7–98.0	95.9	94.8–96.8
	20–44	2,805	98.4	97.8–98.8	97.9	97.2–98.4	96.5	95.5–97.2	94.4	92.8–95.7
	45–54	729	96.7	95.0–97.8	95.2	93.2–96.7	92.1	89.2–94.3	88.9	83.6–92.5
	55–64	494	93.5	90.7–95.5	90.0	86.5–92.7	85.7	81.0–89.2	81.9	74.8–87.2
	65–74	250	90.7	85.7–94.0	87.0	81.0–91.2	80.2	71.9–86.3	75.1	57.7–86.1
	75+	116	85.8	76.1–91.8	83.0	71.3–90.2	80.9	64.9–90.2	76.3	38.0–92.7
Tumors of the pineal region	0–19	90	98.9	91.7–99.8	98.9	91.7–99.8	98.9	91.7–99.8	96.7	84.8–99.3
	20–44	314	96.7	93.9–98.3	96.1	93.0–97.8	95.4	91.8–97.5	94.9	90.6–97.3
	45–54	107	93.6	86.5–97.0	93.6	86.5–97.0	93.4	84.9–97.2	90.9	79.5–96.1
	55–64	93	91.9	83.5–96.1	90.2	80.9–95.1	83.0	70.3–90.6	62.1	30.6–82.6
	65–74	61	90.9	78.1–96.4	86.2	71.1–93.7	79.5	58.5–90.7	78.4	44.9–92.9
	75+	--	--	--	--	--	--	--	--	--
Nerve sheath tumors	0–19	2,787	99.8	99.5–99.9	99.6	99.2–99.8	98.9	98.3–99.3	97.5	96.3–98.3
	20–44	15,012	99.5	99.4–99.7	99.3	99.1–99.4	98.8	98.5–99.0	98.2	97.7–98.7

Table 24 Continued

Histology	Age group (year)	N[c]	1-Year		2-Year		5-Year		10-Year	
			%	95% CI	%	95% CI	%	95% CI	%	95% CI
	45–54	15,479	99.6	99.5–99.7	99.6	99.3–99.7	99.5	99.2–99.7	99.5	99.2–99.7
	55–64	17,350	99.4	99.2–99.5	99.4	99.1–99.6	99.4	99.1–99.6	99.4	99.1–99.6
	65–74	12,010	99.2	98.8–99.4	99.2	98.8–99.4	99.2	98.8–99.4	99.2	98.8–99.4
	75+	6,329	97.6	96.8–98.3	97.6	96.8–98.3	97.6	96.8–98.3	97.6	96.8–98.3
Meningioma	0–19	1,158	98.8	97.9–99.3	98.3	97.3–99.0	96.6	95.1–97.6	92.3	89.2–94.5
	20–44	31,887	98.6	98.5–98.8	98.1	97.9–98.2	96.8	96.6–97.1	94.8	94.3–95.2
	45–54	45,550	97.9	97.7–98.0	97.1	97.0–97.3	95.5	95.2–95.8	93.3	92.8–93.8
	55–64	60,364	96.1	95.9–96.2	94.7	94.5–94.9	92.3	91.9–92.6	88.7	88.1–89.2
	65–74	64,743	93.2	93.0–93.5	91.2	90.9–91.4	87.3	86.9–87.7	81.3	80.4–82.1
	75+	86,984	85.8	85.5–86.1	83.0	82.6–83.4	76.9	76.3–77.5	68.9	67.5–70.3
Mesenchymal tumors	0–19	600	99.7	98.0–99.9	98.7	97.0–99.4	97.2	94.8–98.5	95.4	91.5–97.5
	20–44	673	98.5	97.1–99.2	98.3	96.7–99.1	97.0	94.9–98.3	93.7	89.4–96.3
	45–54	390	97.7	95.3–98.9	96.9	94.1–98.4	93.5	89.1–96.1	86.8	79.0–91.8
	55–64	367	96.8	93.9–98.3	95.2	91.6–97.2	90.5	85.3–94.0	83.4	71.9–90.5
	65–74	272	92.8	88.2–95.6	90.9	85.5–94.3	84.5	76.5–89.9	71.0	53.9–82.7
	75+	151	84.8	76.2–90.4	84.8	76.2–90.4	71.5	54.6–83.0	52.8	27.1–73.1
Other neoplasms related to the meninges	0–19	344	98.5	96.4–99.4	97.9	95.5–99.0	95.8	92.4–97.7	88.8	81.5–93.4
	20–44	2,158	98.4	97.7–98.9	97.8	97.0–98.4	96.8	95.7–97.5	94.2	92.2–95.6
	45–54	1,205	96.9	95.6–97.8	96.3	94.9–97.4	95.4	93.5–96.8	91.5	87.7–94.2
	55–64	1,075	96.2	94.6–97.3	95.7	93.9–97.0	93.3	90.7–95.2	90.6	85.3–94.1
	65–74	705	93.4	90.9–95.2	91.9	88.9–94.1	88.1	83.5–91.4	88.0	82.2–92.0
	75+	401	85.5	80.7–89.2	84.4	78.6–88.7	81.5	73.5–87.3	60.0	40.6–74.8
Germ cell tumors, cysts, and heterotopias	0–19	443	97.6	95.5–98.7	96.8	94.5–98.2	96.2	93.7–97.8	95.8	93.1–97.5
	20–44	352	98.7	96.5–99.5	98.2	95.7–99.2	97.5	94.4–98.9	94.7	86.8–97.9
	45–54	140	94.5	88.7–97.3	94.0	87.9–97.1	92.2	84.4–96.2	84.3	71.7–91.6
	55–64	78	98.2	86.6–99.8	98.2	86.6–99.8	98.2	86.6–99.8	83.9	52.7–95.3
	65–74	74	94.5	83.9–98.2	93.1	80.5–97.6	85.5	68.8–93.7	85.5	68.8–93.7
	75+	--	--	--	--	--	--	--	--	--
Tumors of the pituitary	0–19	6,053	99.9	99.8–100.0	99.8	99.6–99.9	99.8	99.5–99.9	99.2	98.7–99.6
	20–44	45,659	99.6	99.5–99.6	99.4	99.3–99.5	99.1	98.9–99.2	98.4	98.1–98.7
	45–54	23,601	98.8	98.6–99.0	98.5	98.2–98.7	97.7	97.4–98.0	96.5	95.9–97.1
	55–64	22,384	98.0	97.8–98.2	97.5	97.2–97.8	96.9	96.4–97.3	95.0	93.9–95.8
	65–74	18,446	96.8	96.5–97.1	96.2	95.7–96.6	94.8	94.1–95.5	91.5	89.6–93.0

Table 24 Continued

Histology	Age group (year)	N[c]	1-Year		2-Year		5-Year		10-Year	
			%	95% CI	%	95% CI	%	95% CI	%	95% CI
	75+	13,400	92.9	92.3–93.5	91.9	91.0–92.7	87.2	85.7–88.6	79.4	75.4–82.8
Craniopharyngioma	0–19	1,904	98.5	97.8–99.0	97.7	96.8–98.3	95.1	93.9–96.1	92.7	90.9–94.2
	20–44	1,679	95.0	93.8–96.0	93.1	91.7–94.3	89.3	87.5–90.9	84.7	82.1–87.0
	45–54	1,036	91.3	89.4–93.0	90.0	87.8–91.8	84.8	82.0–87.2	79.6	75.5–83.1
	55–64	966	90.9	88.7–92.6	88.1	85.5–90.2	81.4	78.0–84.3	75.5	69.9–80.2
	65–74	643	83.2	79.8–86.1	76.8	72.8–80.3	68.3	63.3–72.8	55.1	46.4–63.0
	75+	348	84.0	78.8–88.0	78.4	72.1–83.5	65.1	55.9–72.8	54.0	42.4–64.3
Hemangioma	0–19	1,011	99.3	98.5–99.7	99.0	98.1–99.5	98.3	97.0–99.1	97.0	93.7–98.6
	20–44	3,340	99.2	98.8–99.5	98.8	98.3–99.2	98.1	97.4–98.7	96.2	94.5–97.3
	45–54	1,970	97.9	97.0–98.5	97.1	96.1–97.9	94.9	93.4–96.2	94.1	91.8–95.7
	55–64	1,803	96.1	95.0–97.0	95.1	93.7–96.1	93.2	91.2–94.7	86.6	81.1–90.6
	65–74	1,253	92.8	91.0–94.3	90.4	88.1–92.2	85.9	82.4–88.8	83.6	76.6–88.7
	75+	954	89.2	86.3–91.5	86.9	83.2–89.8	82.9	76.3–87.8	71.0	50.8–84.1
Neoplasm, unspecified	0–19	1,390	96.3	95.1–97.2	95.9	94.7–96.9	95.5	94.2–96.5	94.5	92.7–95.8
	20–44	3,282	94.7	93.8–95.4	93.3	92.4–94.2	91.5	90.4–92.5	89.0	87.4–90.5
	45–54	1,944	89.4	87.9–90.7	87.0	85.3–88.5	83.9	81.9–85.7	76.6	73.3–79.5
	55–64	2,075	82.7	81.0–84.4	78.0	76.0–79.8	72.2	69.8–74.4	66.2	62.6–69.5
	65–74	2,134	73.8	71.8–75.7	68.6	66.4–70.7	62.5	59.8–65.0	52.8	48.3–57.1
	75+	4,071	44.6	42.9–46.2	41.2	39.4–42.9	33.8	31.6–36.0	24.6	20.9–28.5
TOTAL[d]	**0–19**	**21,369**	**99.1**	**99.0–99.2**	**98.7**	**98.5–98.9**	**97.9**	**97.6–98.1**	**96.4**	**96.0–96.8**
	20–44	**110,384**	**99.0**	**98.9–99.0**	**98.6**	**98.5–98.7**	**97.8**	**97.7–97.9**	**96.4**	**96.2–96.6**
	45–54	**93,842**	**98.1**	**98.0–98.2**	**97.5**	**97.4–97.7**	**96.3**	**96.2–96.5**	**94.7**	**94.4–95.0**
	55–64	**108,382**	**96.7**	**96.5–96.8**	**95.6**	**95.5–95.8**	**93.9**	**93.7–94.2**	**91.4**	**91.0–91.8**
	65–74	**101,457**	**94.1**	**93.9–94.2**	**92.4**	**92.2–92.7**	**89.6**	**89.2–89.9**	**85.0**	**84.3–85.7**
	75+	**113,322**	**85.8**	**85.6–86.1**	**83.4**	**83.1–83.7**	**78.1**	**77.6–78.6**	**71.1**	**69.9–72.3**

a. The cohort analysis of survival rates was utilized for calculating the survival estimates presented in this table. Long-term cohort-based survival estimates reflect the survival experience of individuals diagnosed over the time period, and they may not necessarily reflect the long-term survival outlook of newly diagnosed cases.
b. Rates are an estimate of the percentage of patients alive at one, two, five, and ten years, respectively.
c. Total number of case that occurred within the NPCR registries between 2004 and 2015.
d. Total includes histologies not listed in this table.
- Rates were not presented for categories with 50 or fewer cases and were suppressed for rates where fewer than 16 cases were surviving within a category.
*** Confidence interval could not be calculated.*
Abbreviations: CBTRUS, Central Brain Tumor Registry of the United States; NPCR, National Program of Cancer Registries; CI, Confidence Interval; NOS, Not otherwise specified

Table 25 Summary of biomarkers identified for primary brain and other CNS tumors

Histology	Gene or Marker	Outcome	Related scientific publications	Collected by US Cancer Registry System
Glioma (especially oligodendroglial tumors)	Large deletions (missing parts of the chromosome) in the short arm of chromosome 1 (1p) and the long arm of chromosome 19 (19q)	Improved response to chemotherapy and radiation, and increased survival	Cairncross JG, Ueki K et al. (1998)[79] Vogelbaum MA, Hu C et al. (2015)[80] van den Bent MJ, Brandes AA et al. (2013)[81] The Cancer Genome Atlas Research Network, Brat DJ et al. (2015)[82] Ceccarelli M, Barthel FP et al. (2016)[83]	Yes Site-specific factor 5: http://web2.facs.org/cstage0205/brain/Brain_nph.html Site-specific factor 6: http://web2.facs.org/cstage0205/brain/Brain_opf.html
Glioma (especially low grade astrocytomas and oligodendroglial tumors)	Protein-truncating mutation in isocitrate dehydrogenase 1 (*IDH1*) or in isocitrate dehydrogenase 2 (*IDH2*)	Increased survival time	Yan H, Parsons DW et al. (2009)[84] The Cancer Genome Atlas Research Network, Brat DJ et al. (2015)[82] Ceccarelli M, Barthel FP et al. (2016)[83]	Yes Began in collection year 2018 (January 1), http://datadictionary.naaccr.org/default.aspx?c=10#3816
Glioma (especially IDH mutated glioma)	Loss of function mutation in alpha thalassemia/mental retardation syndrome X-linked (*ATRX*)	Increased survival time	Jiao Y, Killela PJ et al. (2012)[110] Wiestler B, Capper D et al. (2013)[112] The Cancer Genome Atlas Research Network, Brat DJ et al. (2015)[82]	No
Glioblastoma	Methylation of the promoter of O-6-methylguanine-DNA methyltransferase (*MGMT*)	Limits ability of the tumor cells to repair DNA damage caused by chemotherapy and radiation; results in increased survival time	Hegi ME, Diserens AC et al. (2005)[85] Stupp R, Hegi ME et al. (2007)[86] Hegi ME, Liu L et al. (2008)[87]	Yes Site-specific factor 4: http://web2.facs.org/cstage0205/brain/Brain_mpn.html
Glioblastoma	Glioma-CpG island methylator phenotype (G-CIMP), Genome-wide DNA methylation	Significantly increased survival time	Noushmehr H, Weisenberger DJ et al. (2010)[88]	No
Glioblastoma	Amplification of epidermal growth factor receptor (*EGFR*)	Activates the RTK/RAS/PI3K pathway, leading to increased proliferation. Associated with poorer survival.	Maire CL and Ligon KL (2014) [113] Ceccarelli M, Barthel FP et al. (2016)[83]	No
Glioma (oligodendroglial tumors and IDH wild type glioblastoma)	Mutation of promotor of Telomerase reverse transcriptase (*TERT*)	Facilitates increased telomere lengthening, and decreases survival in IDH wild type glioma	Arita H, Narita Y et al. (2013) [114] Eckel-Passow JE, Lachance DH et al. (2015) [115] Ceccarelli M, Barthel FP et al. (2016)[83]	No
Glioma (particularly pediatric lower grade gliomas)	Mutation or fusion of B-Raf (*BRAF*)	Activates the RAS/MAPK pathway. Fusion leads to improved survival.	Hawkins C, Walker E et al. (2011)[116]	No
Medulloblastoma	Wingless (WNT) subtype	Low prevalence of metastatic disease (~5–10%) Highest five-year survival (~95%)	Kool M, Korshunov A et al. (2012)[89] Northcott PA, Dubuc AM et al. (2012)[90] Northcott PA, Jones DT et al. (2012)[91] Northcott PA, Buchhalter I et al. (2017)[92]	Yes Began in collection year 2018 (January 1), http://datadictionary.naaccr.org/default.aspx?c=10#3816
Medulloblastoma	Sonic hedgehog subtype (SHH)	Moderate prevalence of metastatic disease (~15–20%) Moderate five-year survival (~75%)	Kool M, Korshunov A et al. (2012)[89] Northcott PA, Dubuc AM et al. (2012)[90] Northcott PA, Jones DT et al. (2012)[91] Northcott PA, Buchhalter I et al. (2017)[92]	Yes Began in collection year 2018 (January 1), http://datadictionary.naaccr.org/default.aspx?c=10#3816
Medulloblastoma	Group 3 subtype (also known as Group C)	Increased prevalence of metastatic disease (~40–45%) Poorest five-year survival (~50%)	Kool M, Korshunov A et al. (2012)[89] Northcott PA, Dubuc AM et al. (2012)[90] Northcott PA, Jones DT et al. (2012)[91] Northcott PA, Buchhalter I et al. (2017)[92]	Yes Began in collection year 2018 (January 1), http://datadictionary.naaccr.org/default.aspx?c=10#3816

Table 25 Continued

Histology	Gene or Marker	Outcome	Related scientific publications	Collected by US Cancer Registry System
Medulloblastoma	Group 4 subtype (also known as Group D)	Increased prevalence of metastatic disease (40–45%) Moderate five-year survival (~75%)	Kool M, Korshunov A et al. (2012)[89] Northcott PA, Dubuc AM et al. (2012)[90] Northcott PA, Jones DT et al. (2012)[91] Northcott PA, Buchhalter I et al. (2017)[92]	Yes Began in collection year 2018 (January 1), http://datadictionary.naaccr.org/default.aspx?c=10#3816
Embryonal tumor	C19MC amplification and presence of multilayered rosettes	Highly aggressive, with average survival of 12 months after diagnosis	Ceccom J, Bourdeaut F et al. (2014)[117] Korshunov A, Sturm D et al. (2014)[118]	Yes Began in collection year 2018 (January 1), http://datadictionary.naaccr.org/default.aspx?c=10#3816