Neuro-Oncology
22(S1), 1–96, 2020 | doi:10.1093/neuonc/noaa200

CBTRUS Statistical Report: Primary Brain and Other Central Nervous System Tumors Diagnosed in the United States in 2013–2017

Quinn T. Ostrom,[†] Nirav Patil,[†] Gino Cioffi, Kristin Waite, Carol Kruchko, Jill S. Barnholtz-Sloan

Central Brain Tumor Registry of the United States, Hinsdale, Illinois, USA (Q.T.O., N.P., G.C., K.W., C.K., J.S.B-S.); Department of Medicine, Section of Epidemiology and Population Sciences, Dan L. Duncan Comprehensive Cancer Center, Baylor College of Medicine, Houston, Texas, USA (Q.T.O.); Department of Population and Quantitative Health Sciences, Case Western Reserve University School of Medicine, Cleveland, Ohio, USA (N.P., G.C., K.W., J.S.B-S.); Case Comprehensive Cancer Center, Case Western Reserve University School of Medicine, Cleveland, Ohio, USA (J.S.B-S.); Cleveland Center for Health Outcomes Research, Cleveland, Ohio, USA (N.P., G.C., K.W., J.S.B-S.); University Hospitals Health System, Research and Education Institute (N.P., J.S.B-S.);

[†]These authors contributed equally

Corresponding Author: Jill S. Barnholtz-Sloan, Department of Population and Quantitative Health Sciences, Case Western Reserve University School of Medicine, 2–526 Wolstein Research Building, 2103 Cornell Road, Cleveland, Ohio 44106–7295, 216-368-1506 (Phone) (jsb42@case.edu).

Abstract

The Central Brain Tumor Registry of the United States (CBTRUS), in collaboration with the Centers for Disease Control (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. This report contains the most up-to-date population-based data on primary brain tumors (malignant and non-malignant) and supersedes all previous CBTRUS reports in terms of completeness and accuracy. All rates (incidence and mortality) 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 23.79 (Malignant AAAIR=7.08, non-Malignant AAAIR=16.71). This rate was higher in females compared to males (26.31 versus 21.09), Blacks compared to Whites (23.88 versus 23.83), and non-Hispanics compared to Hispanics (24.23 versus 21.48). The most commonly occurring malignant brain and other CNS tumor was glioblastoma (14.5% of all tumors), and the most common non-malignant tumor was meningioma (38.3% 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 6.14. An estimated 83,830 new cases of malignant and non-malignant brain and other CNS tumors are expected to be diagnosed in the US in 2020 (24,970 malignant and 58,860 non-malignant). There were 81,246 deaths attributed to malignant brain and other CNS tumors between 2013 and 2017. This represents an average annual mortality rate of 4.42. The 5-year relative survival rate following diagnosis of a malignant brain and other CNS tumor was 36.0% and for a non-malignant brain and other CNS tumor was 91.7%.

Executive Summary

The Central Brain Tumor Registry of the United States (CBTRUS), in collaboration with the Centers for Disease Control (CDC) and the 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 2013-2017* 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 CBTRUS 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 primary malignant and non-malignant brain and other CNS tumors for the years 2013-2017 was 23.79 per 100,000.**
- This rate was higher in females compared to males (26.31 versus 21.09 per 100,000), slightly higher Blacks compared to Whites (23.88 versus 23.83 per 100,000), and higher in non-Hispanics (of any race) compared to Hispanics (24.23 versus 21.48 per 100,000).
- The average annual age-adjusted incidence rate of primary **malignant** brain and other CNS tumors was 7.08 per 100,000.
- The average annual age-adjusted incidence rate of primary **non-malignant** brain and other CNS tumors was 16.71 per 100,000.
- Approximately 29.7% of all primary brain and other CNS tumors were **malignant** and 70.3% were **non-malignant,** which makes **non-malignant** tumors more than twice as common as **malignant** tumors.
- The most commonly occurring primary **malignant** brain and other CNS tumor was glioblastoma (14.5% of all tumors and 48.6% of **malignant tumors**), and the most common primary **non-malignant** tumor was meningioma (38.3% of all tumors and 54.5% 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 primary **malignant** and **non-malignant** brain and other CNS tumors was 6.14 per 100,000 between 2013 and 2017. Incidence was higher in females compared to males (6.22 versus 6.07 per 100,000), Whites compared to Blacks (6.36 versus 4.83 per 100,000), and non-Hispanics compared to Hispanics (6.42 versus 5.26 per 100,000).
- An estimated 83,830 new cases of primary **malignant** and **non-malignant** brain and other CNS tumors are expected to be diagnosed in the US in 2020. This includes an expected 24,970 primary **malignant** and 58,860 primary **non-malignant** tumors.

Mortality

- There were 81,246 deaths attributed to primary **malignant** brain and other CNS tumors for the five-year period between 2013 and 2017. This represents an average annual mortality rate of 4.42 per 100,000, and an average of 16,249 deaths per year caused by primary **malignant** brain and other CNS tumors.

Survival

- Median observed survival in primary **malignant** brain and other CNS tumors only was lowest for glioblastoma (8 months) and highest for malignant tumors of the pituitary (139 months, or approximately 11.5 years).
- The five-year relative survival rate following diagnosis of a primary **malignant** brain and other CNS tumor was 36.0%. Survival following diagnosis with a primary **malignant** brain and other CNS tumor was highest in persons age 0-14 years (*75.4*%), compared to those ages 15-39 years (*72.5*%) or 40+ years (*21.5* %).
- The five-year relative survival rate following diagnosis of a primary **non-malignant** brain and other CNS tumor was 91.7%. Survival following diagnosis with a primary **non-malignant** brain and other CNS tumor was highest in persons age 15-39 years (*98.2*%), compared to those ages 0-14 years (*97.3*%) or 40+ years (*90.2*%).

Introduction

The objective of the *CBTRUS Statistical Report: Primary Brain and Other Central Nervous System Tumors Diagnosed in the United States in 2013-2017* 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. The Central Brain Tumor Registry of the United States (CBTRUS) obtained the latest available population-based data on all newly diagnosed primary brain and other CNS tumors from the Centers for Disease Control and Prevention's (CDC) National Program of Cancer Registries (NPCR), and the National Cancer Institute's (NCI) Surveillance, Epidemiology, and End Results (SEER) program for diagnosis years 2013-2017. Incidence counts and rates of primary malignant and non-malignant brain and other CNS tumors are presented by histology, sex, age, race, Hispanic ethnicity, and geographic location. Mortality rates calculated using the National Vital Statistics System (NVSS) data from 2013-2017, and both relative survival rates and median survival for selected malignant and non-malignant histologies calculated using SEER and NPCR data for the period 2001-2016, 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/about/).[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 population-based central registry focused on all primary brain and other CNS tumors in the US.

This report represents the twenty-eighth (28th) anniversary of CBTRUS and the twenty-third (23rd) statistical report published by CBTRUS. For this ninth (9th) 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] 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 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 and survival 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. Beginning with this report, the CBTRUS database now includes both survival data from 49 CCRs and incidence data from all 51 CCRs in the US. There are several other brain-specific registry systems in existence, including the Canadian Brain Tumor Registry,[8] the Austrian Brain Tumor Registry,[9] and the Swedish Brain Tumor Registry,[10] 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 a greater proportion 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).*[11]

Technical Notes

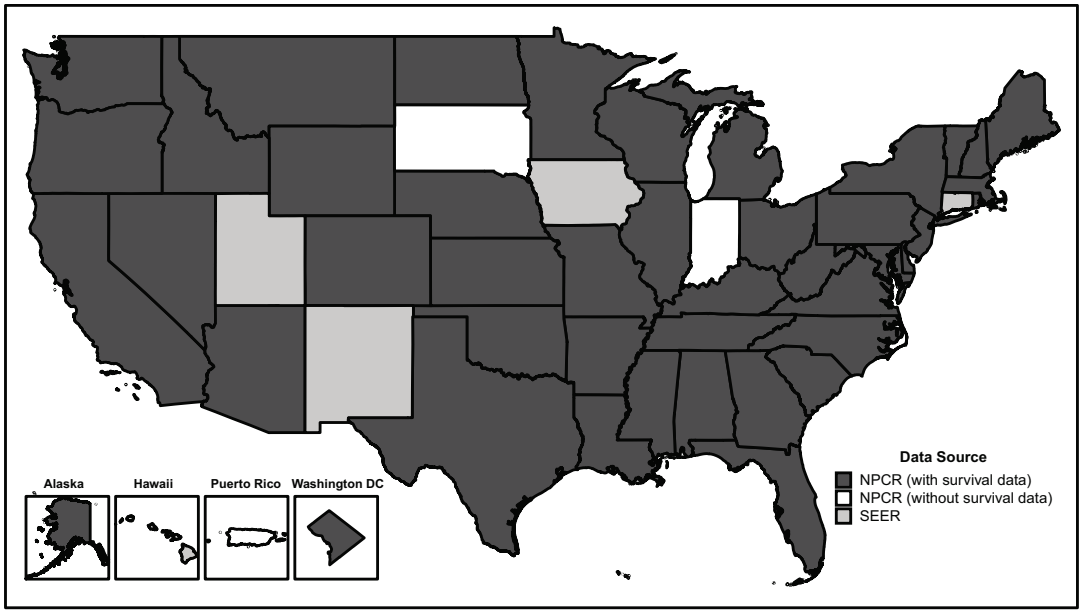
Data Collection

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 occur and is then transmitted to the CCR, which further transmits this information to NPCR and/or SEER. Some CCRs also send their data to SEER; data from those CCRs are taken from the NPCR file to eliminate duplicate cases. 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 CCRs play an essential role in the collection process. 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 de-identified incidence data from 52 CCR (48 NPCR and 4 SEER [SEER data available until year 2016 only]) 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. 1**). **Data were requested for all newly-diagnosed primary malignant and non-malignant tumors from 2013 to 2017 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**).[12]

NPCR provided data on 419,321 primary brain and other CNS tumors diagnosed from 2013 to 2017 (**Fig. 2**). An additional 10,267 primary brain and other CNS tumor case records for the period were obtained from SEER for primary brain and other CNS tumor case records from 2013 to 2016 for Connecticut, Hawaii, Iowa, and New Mexico only. These data were combined into a single dataset of 429,588 records for quality control. A total of 11,821 records (2.71%) were deleted from the final analytic dataset for one or more of the following reasons:

- Records with ICD-O-3 behavior code of /2 (Indicates in situ cases, which is not a relevant classification for brain and other CNS tumors).



SEER Data obtained from the SEER research data files for these population-based central cancer registries (CCR) for incidence calculations. These data do not include 2017 data.
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 SEER and NPCR Incidence (2013-2017, varying) and Survival Data (2001-2016)

- Records with an 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 (e.g. 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 417,767 records, which included 415,411 records from the 50 state CCR and the District of Columbia used in the analytic dataset, and an additional 2,356 records from Puerto Rico. **Records from Puerto Rico are included only in a supplementary analysis (See Supplemental Material), 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.[11] This database includes both NPCR and SEER data and represents the entire US population.

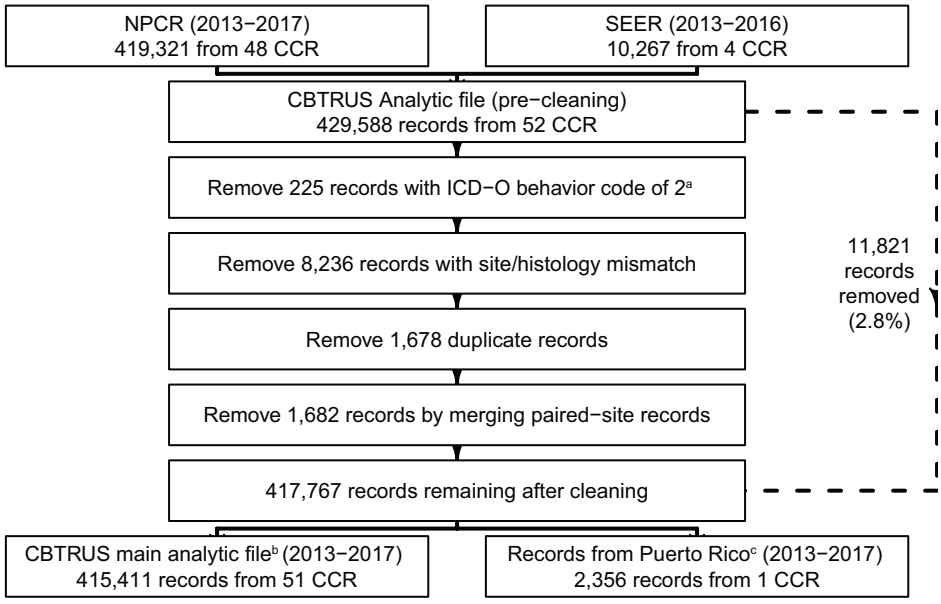
De-identified survival data for malignant brain and other CNS tumors were obtained from the US Cancer Statistics program for 45 NPCR registries for the years 2001 to 2016 and for non-malignant brain and other CNS tumors for the years 2004 to 2016. This dataset provides population-based information for 93.6% of the US population 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) National Vital Statistics System (NVSS) and include deaths where primary brain or other CNS tumor was listed as primary cause of death on the death certificate for individuals from all 50 states and the District of Columbia. These data were obtained from NVSS[13] (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. 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, observed survival (median survival time and hazard ratios) and relative survival rates (for more information on definitions of terms and measures used see: https://cbtrus.org/cbtrus-glossary/).



SEER=Surveillance, Epidemiology, and End Results
Abbreviations: CBTRUS=Central Brain Tumor Registry of the United States; CCR=Central Cancer Registry; NPCR=National Program of Cancer Registries;
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 specified.
c. Data from Puerto Rico is presented in Supplementary Figure 12 only.

Fig. 2 Overview of CBTRUS Data Cleaning Workflow, NPCR 2013-2017 and SEER 2013-2016

Variable Completeness in Cancer Registration

Obtaining the most accurate and complete cancer registration data possible is essential to generate accurate population-level statistics to guide public health planning. Agencies such as NAACCR and IACR have developed stringent standards for evaluation of cancer registry data quality, and evaluate each specific registry by multiple metrics before including it in analytic datasets.[14,15] While many measures of quality and completeness are assessed across all cancer sites, some variables are pertinent only to specific sites and/or histologies and require special care. In the case of primary brain and other CNS tumors, variables such as WHO grade are not relevant to histologies (e.g. many tumors of the pituitary) that are not assigned a WHO grade. Variables like WHO grade may also not be expected to be found in the patient record for those who had their diagnosis confirmed via radiography as compared to histological examination. The report evaluates the completeness of multiple variables, including: WHO grade, radiation treatment, and chemotherapeutic treatment.

Classification by Histology

There are over 100 histologically distinct types of primary CNS tumors, each with its own spectrum of clinical presentations, treatments, and outcomes. These histologies are reviewed periodically by neuropathologists and published by the World Health Organization (WHO) in Classification Reports known as "Blue Books". Blue Books are published for all cancer sites by WHO and utilize the International Classification of Diseases for Oncology, third edition (ICD-O-3) for assignment of histology, behavior, and site codes. This report uses the *2007 WHO Classification of Tumors of the Central Nervous System* to guide its reporting, the most recent being the 2012 CBTRUS Histology Grouping (**Table 2**). The ICD-O-3 codes in this current CBTRUS Grouping [12] may include morphology codes that were not previously reported to CBTRUS.[16] In this report, incidence rates are provided for major histology groupings and for specific histologies found in the 2012 CBTRUS Histology Grouping. CBTRUS will be using a Histology Grouping according to *2016 WHO Classification of CNS Tumours* in its 2021 Report at which time the CBTRUS Histology Grouping will be updated.

Gliomas are tumors that arise from glial or precursor cells and include astrocytoma (including glioblastoma), oligodendroglioma, ependymoma, oligoastrocytoma (mixed glioma), 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 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 brain and other CNS tumors. ICCC categories for this report were generated using the SEER Site/Histology ICCC-3 Recode[17] based on the ICCC, Third edition[18] and 2007 WHO

Classification of Tumours of Haematopoietic and Lymphoid Tissues[19] (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 8 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.

Classification by Behavior

Primary brain and other CNS tumors can be broadly classified in non-malignant (ICD-O-3 behavior codes of /0 for benign and /1 for uncertain) and malignant (ICD-O-3 behavior code of /3) (**Table 2**). Collection of central (state) cancer data was mandated in 1992 by Public Law 102-515 for all primary malignant tumors (ICD-O-3 behavior code of /3) (**Table 2**), the Cancer Registries Amendment Act.[5] This mandate was expanded to include **non-malignant brain and other CNS tumors** (ICD-O-3 behavior code of /0 and /1) with the 2002 passage of Public Law 107–260, starting January 1, 2004.[6] Collection of metastatic tumors are not included in these public laws. CBTRUS reports data on all 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 primary 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.**

Classification by WHO Grade

Unlike other types of cancer which are staged according to the American Joint Commission of Cancer (AJCC) Collaborative Staging (CS) schema, 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*[20] 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[21] 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.

The WHO grading assignments are recorded by cancer registrars as Collaborative Stage Site-Specific Factor 1 - WHO Grade Classification as directed in the AJCC Chapter 72 on Brain and Spinal Cord [22] 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.[23,24] 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 based on the topography codes found in ICD-O-3 and are broadly based on the categories and site codes defined in the SEER Site/Histology Validation List.[25] See **Table 1** for an overview of CBTRUS primary site groupings.

Statistical Methods

Statistical Software

Counts, means, medians, rates, ratios, proportions, and other relevant statistics were calculated using R 4.0 statistical software[26] and/or SEER*Stat 8.3.6.[27] Figures and tables were created in R 4.0.0 using the following packages: knitr, flextable, officer, orca, plotly, SEER2R, sf, survminer, tigris, and tidyverse.[28-37] 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.**

Variable Definitions

CBTRUS presents statistics on the pediatric and adolescent age- group 0-19 years as suggested by clinicians, for clinical relevance. However, the 0-14 years 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.[38] 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).[39]

Estimation of Incidence Rates and Incidence Rate Ratios

Population data for each geographic region were obtained from the SEER program website[40] 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), average annual age-adjusted mortality rates 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.[41] The age distribution of the 2000 US standard population is presented in Supplementary Table 2. Combined populations for the regions included in this report are also presented in Supplementary Table 3, Supplementary Table 4, and Supplementary Table 5.

Incidence rate ratios (IRR) were generated based on these age-adjusted incidence rates. These IRR were used to compare groups, using the formulas described by Fay et al. to calculate p-values.[42] Incidence rate ratios were considered statistically significantly different when the p-value was less than 0.05.

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 a 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.

Estimation of Expected Numbers of Brain and Other CNS Tumors in 2020 and 2021

Estimated numbers of expected primary malignant and non-malignant brain and other CNS tumors were calculated for 2020 and 2021. To project estimates of newly diagnosed brain and other CNS tumors in 2020 and 2021, age-adjusted annual brain tumor incidence rates were generated for 2000-2017 for malignant tumors, and 2006-2017 for non-malignant tumors. These were generated by state, age, and histologic type. Joinpoint 4.7.0.0[43] was used to fit regression models to these incidence rates,[44] 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.[45] 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.[13] These data were available for 50 states and the District of Columbia only. In addition to the total age-adjusted rate for the US, age-adjusted rates are presented by sex and state.

Estimation of Incidence-Based Mortality Rates for Brain and Other CNS Tumors

US cancer registry vital status are usually derived from death certificate data, which are coded using the ICD classification scheme. While this scheme for estimating mortality rates classifies deaths due to a brain tumor by site of tumor, it does not allow for partitioning by specific histology. Incidence-based mortality is a method that estimates mortality using population-level cancer registry data, rather than death certificates, and as a result allows for partitioning by additional variables abstracted as part

of the process of cancer registration.[46] Incidence-based age-adjusted mortality rates for deaths resulting from all primary **malignant** brain and other CNS tumors were calculated using the data from 18 central cancer registries included in the SEER 18 [47] available in SEER*Stat Online from diagnosis years 2008-2017. These registries represent 28% of the US population and are a subset of those registries included in the overall CBTRUS analytic dataset. **Caution must be used in interpreting these results, as they can be affected by factors, such as reporting delay and lead-time bias, which generally do not affect mortality rates estimated from death certification data**.

Survival Measures Used In This Report

Relative Survival Rates

Relative survival is a way of presenting survival patterns at a population level that is commonly used in cancer statistics reporting. This measure is presented as a percent of people living a period of time (e.g. five years after their diagnosis). Relative survival is calculated using **observed survival** (the percentage of people diagnosed with cancer that live to the period of time for which relative survival is calculated) and **estimated survival** (the percent of the general population of the same age that is expected to survival after being followed for that same period of time). This adjustment for estimated survival attempts to exclude deaths that would otherwise have occurred due to other causes. For example, if five-year relative survival for glioblastoma is 5%, that means that out of every hundred people diagnosed with glioblastoma five will be living five years after diagnosis, excluding deaths due to other causes.

SEER*Stat 8.3.6 statistical software was used to estimate one-, two-, three-, four-, five-, and ten-year relative survival rates for primary **malignant** and **non-malignant** brain and other CNS tumor cases diagnosed between 2004-2016 in 45 NPCR CCRs. 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.

Observed Survival with Median Survival Times and Adjusted Hazard Ratios

Median survival time is another way of presenting survival patterns in a population. This measure is calculated using a method called a Kaplan Meier estimator, which is used to estimate the proportion of individuals within a set that are alive at particular time points. The median observed survival time is the point at which exactly 50% of individuals have either died or been 'censored', meaning that their further survival status is unknown beyond a particular date.

Median observed survival time for all primary **malignant** brain and other CNS tumors diagnosed between 2001-2016 in 45 NPCR CCRs was calculated by histology using the Kaplan Meier method in R 4.0.0 statistical software[26] overall, as well as by three major age groups (0-14 years old, 15-39 years old, and 40+ years old). 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.

The hazard ratio is a measure of how often an event (in this case, death) occurs in one group as compared to another group over time. A hazard ratio of one means that survival is equal in both groups, while a ratio of less than one means that observed survival is better in the comparison group than in the reference group. A ratio of greater than one means that survival is worse in the comparison group than in the reference group.

Cox proportional hazard models were used to test associations between demographic factors and overall observed survival by histology for **malignant** brain and other CNS tumors. All models were adjusted for age at diagnosis group (0-14 years [reference], 15-39 years, 40+ years), sex (male [reference], female), race (White [reference], Black, AIAN, API), and ethnicity (non-Hispanic [reference], Hispanic). These models were used to estimate hazard ratios associated with each group and corresponding 95% confidence intervals and p-values. Adjusted estimates included all covariates (age at diagnosis, sex, race, and ethnicity) a priori, regardless of individual significance level. The proportional hazards assumption was tested separately by histology, and residuals were examined for all variables.

Estimation of Incidence Time Trends

Joinpoint 4.7.0.0[43] was used to estimate incidence time trends and generate annual percentage changes (APC) and 95% CI. Rather than calculating a single consistent slope of change over an entire time period, joinpoint allows for points where the slope of the trend can change during the time period (joinpoints). This method starts with a model that assumes one consistent trend over time, and tests whether the addition of these 'joinpoints' results in a model which has a fit that represents a statistically significant improvement over the model with no joinpoints. These models are tested through use of Monte Carlo permutations, e.g. the program repeats the same analysis multiple times using random samples to identify the 'true' proportion of times that a comparison is statistically significant. The models allowed for a maximum of three 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.[45]

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.

Brain Tumor Definition Differences

Currently, NPCR, SEER, and NAACCR report primary 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, tumors of the pituitary, as well as olfactory tumors of the nasal cavity [C30.0 (9522-9523)].[16] Additionally, CBTRUS reports data on all primary brain and other CNS tumors irrespective of behavior, whereas many reporting organizations may only publish rates for 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.**

CBTRUS is currently engaged in ongoing collaboration with other cancer registry reporting groups, including SEER, to harmonize brain tumor reporting definitions. Therefore, it is likely that these reporting differences will cease to exist in the future.

Pilocytic astrocytoma is clinically considered and classified as a Grade I, non-malignant (ICD-O-3 behavior code of /1) tumor by the World Health Organization (WHO) guidelines for brain and other central nervous system (CNS) tumors.[48] For the purposes of cancer registration, these tumors have historically been reported as malignant (ICD-O-3 behavior code of /3) tumors both in the US and by the International Agency for Research on Cancer and International Association of Cancer Registries. [49,50] Classification of these tumors as malignant has been followed by CBTRUS in its reporting unless otherwise stated. This practice does not correlate with clinical classification and presents a challenge to correctly report population-based incidence and survival patterns associated with these tumors. Please see a recent publication for additional discussion of the effect of this classification on cancer incidence and survival reporting.[51]

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.**

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 2013-2017. 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 417,767 tumors cases, from 50 state CCR and the District of Columbia, included in this report came from 409,965 individuals. Of these 409,965 individuals, there were 5,174 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 probable underreporting of cancer data—especially for men—to CCRs. 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.[52,53] It is important to note that improved reporting to VACCR does not necessarily mean that reporting to the state CCR has improved, and 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.[54,55] 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.[56] 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 CCRs reported in this statistical report.[57] 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 CCRs, there is potential evidence of underreporting of non-malignant brain and other CNS tumors, the extent to which cannot be quantified.[57]

- 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.[58,59]

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 brain and other CNS tumors. Editing changes, such as the Multiple Primary and Histology Rules issued in 2007 and revised in 2018,[60,61] 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 Cancer Types in the US

Average annual age-adjusted incidence rates for primary brain and other CNS tumors for the period from 2013-2017 and a selection of common cancers (USCS, also from 2013-2017) in the US are presented by age in **Fig. 3**. Incidence rates stratified by sex are presented by age in Supplementary Figure 1. Please see Supplementary Table 6 for incidence rates of comparison cancers.

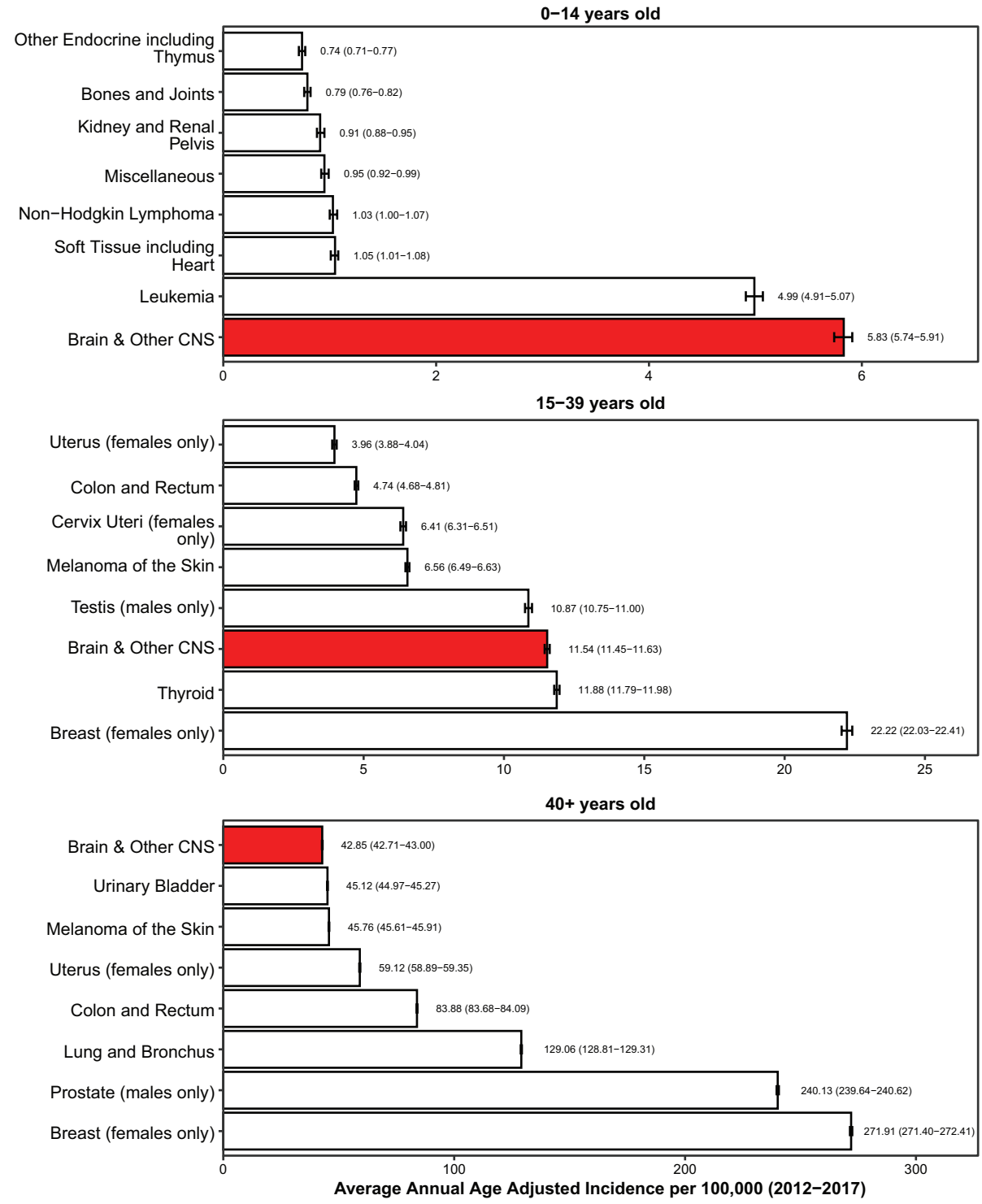
- Brain and other CNS tumors (both malignant and non-malignant) were the most common cancer site in persons age 0-14 years, with an AAAIR of 5.83 per 100,000 population. Brain and other CNS tumors were the most common cancer in both males and females in this age group.
- Leukemia was the 2nd most common neoplasm in persons age 0-14 years, with an AAAIR of 4.99 per 100,000 population. Leukemia was the 2nd most common cancer in both males and females in this age group.
- Testicular cancer was the most common cancer in males age 15-39 years, with an AAAIR of 10.87 per 100,000.
- Breast cancer was the most common cancer among females age 15-39 years, with an AAAIR of 19.59 per 100,000.
- Brain and other CNS tumors (both malignant and non-malignant) among those age 15-39 years had an AAAIR of 11.54 per 100,000 population. These tumors were the 3rd most common cancer overall, the 2nd most common cancer in males in this age group, and the 3rd most common cancer in females in this age group.
- Breast cancer was the most common cancer among females age 40+ years in the US, with AAAIR of 271.91 per 100,000 population.
- The most common cancer among males was prostate cancer, which had an incidence rate of 240.13 per 100,000.
- Brain and other CNS tumors (both malignant and non-malignant) were the 8th most common cancer among persons age 40+ years with an AAAIR of 42.85 per 100,000 population. These tumors were the 9th most common cancer among males and the 5th most common cancer among females in this age group.

Average annual age adjusted mortality rate (AAAMR) for primary malignant brain and other CNS tumors (2013-2017), a selection of common cancers, and the top three non-cancer causes of death in the US are presented by age in **Fig. 4**. Mortality rates for males only and females only are presented by age in Supplementary Figure 2. Please see Supplementary Table 7 for mortality rates due to comparison cancers and other non-cancer conditions.

- The most common causes of death in persons age 0-14 years was perinatal conditions (18.96 per 100,000).
- Malignant brain and other CNS tumors among persons age 0-14 years had an AAAMR of 0.71 per 100,000 and were the most common cause of death in this age group, and the most common cause of cancer death.
- Childhood brain and other 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 at diagnosis.
- Accidents and adverse effects were the leading causes of death in persons age 15-39 years (39.58 per 100,000).
- Malignant brain and other CNS tumors among persons age 15-39 years had an AAAMR of 0.96 per 100,000 and were the 12th most common cause of death in this age group and the 5th most common cause of cancer death, where their AAAMR was similar to that of leukemia.
- Heart disease was the largest contributor to mortality in persons age 40+ years in the US, with an AAAMR of 381.28 per 100,000 for major cardiovascular diseases.
- Malignant brain and other CNS tumors among persons age 40+ years had an AAAMR of 9.12 per 100,000 and were the 26th most common cause of death and the 3rd most common cause of cancer death.

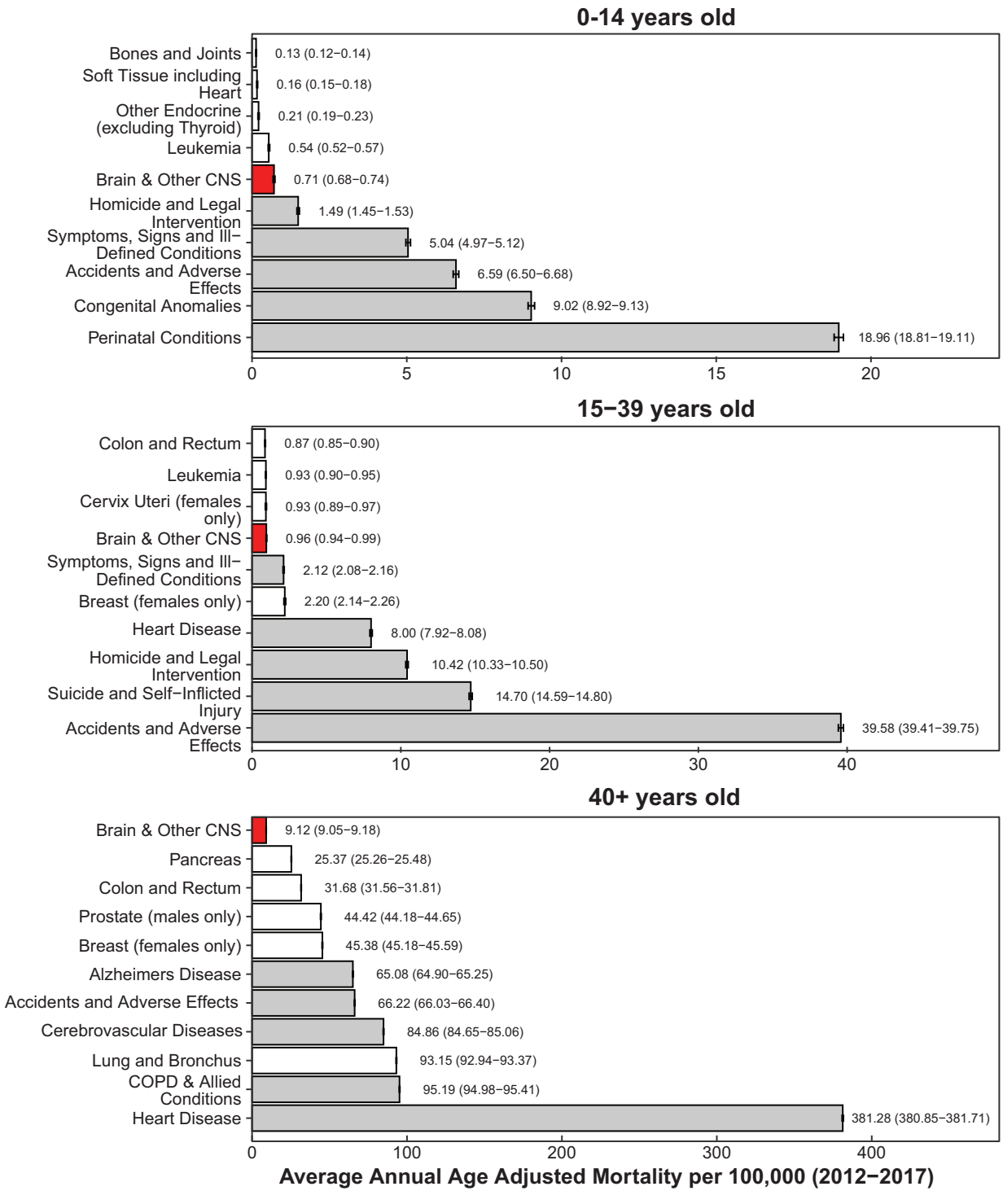
Distributions and Incidence by Site, Behavior, Histology, and Year

Counts and rates from the 415,411 incident brain and other CNS tumors (123,484 malignant; 291,927 non-malignant shown in **Fig. 5**) reported during 2013-2017 by histology and demographic characteristics for all ages are presented



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 Children Age 0-14 Years, Adolescents and Young Adults Age 15-39 Years, and Older Adults Age 40+ Years, CBTRUS Statistical Report: US Cancer Statistics - NPCR and SEER 2013-2017



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 Children Age 0-14 Years, Adolescents and Young Adults Age 15-39 Years, and Older Adults Age 40+ Years, CBTRUS Statistical Report: NVSS 2013-2017

in **Table 3**. Counts and rates are presented by histology and behaviors for selected histologies where there are a sufficient number of cases to calculate rates. The predominant tumor categories by behavior are presented in Supplementary Figures 3.

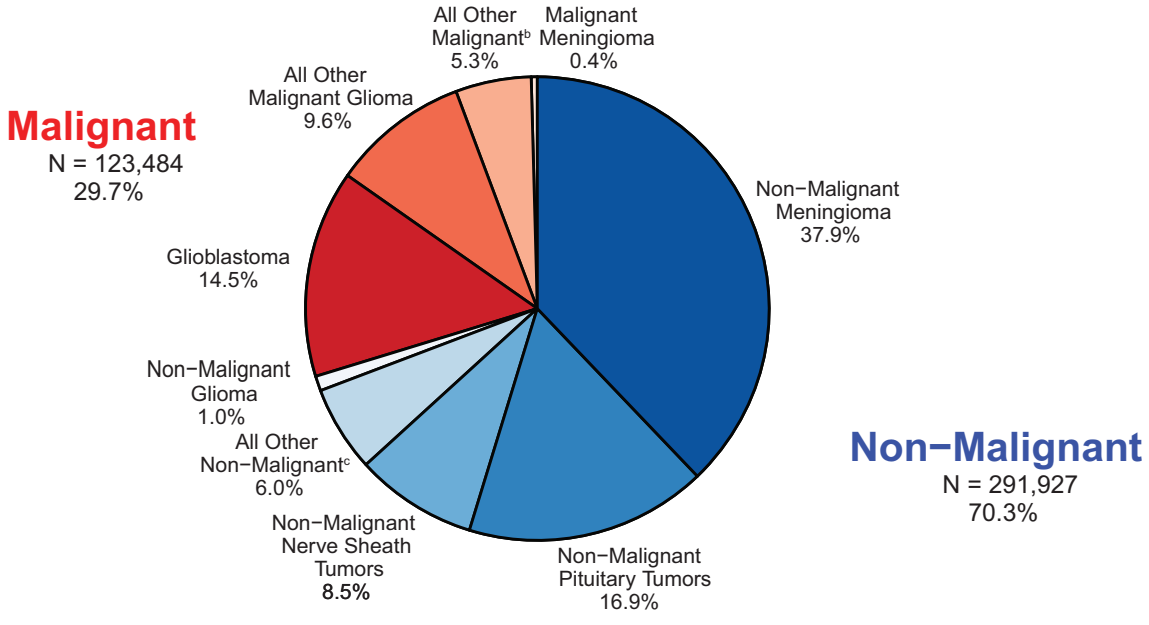
Incidence by Year and Behavior

The overall annual age-adjusted incidence rates of all primary brain and other CNS tumors by year, 2013-2017, and behavior are presented in Supplementary Figure 4. The incidence rates for all primary brain and other CNS tumors, 2013-2017, did not differ substantially by year (both overall and by behavior). AAAIR stratified by sex are presented in Supplementary Figure 5.

Distribution of Tumors by Site and Histology

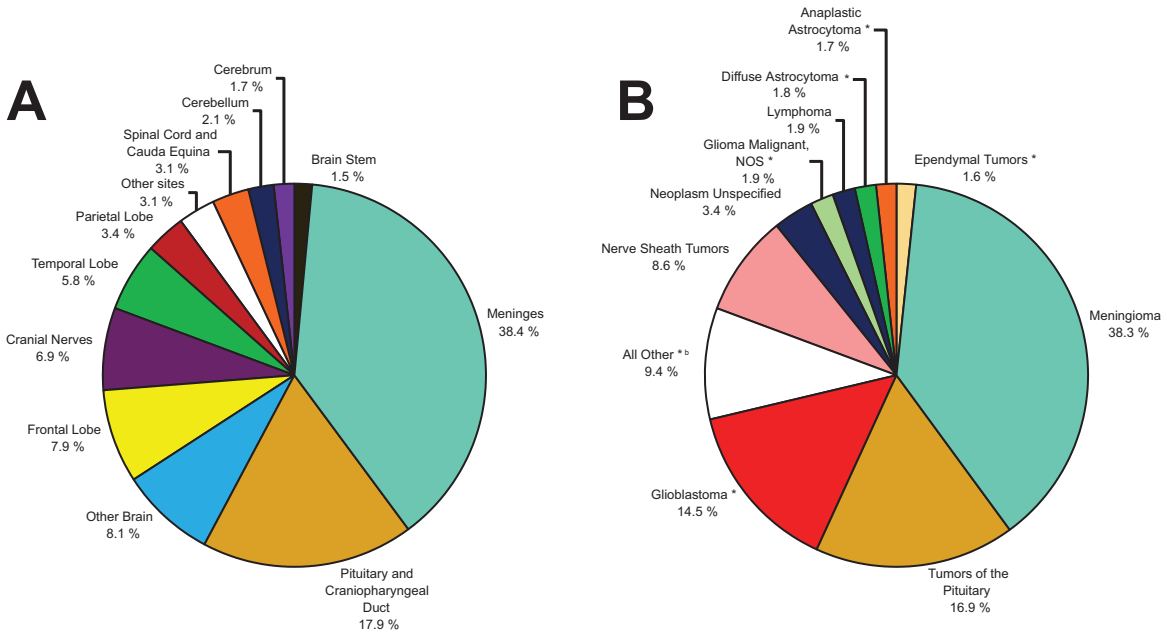
The distribution of all primary brain and other CNS tumors by site and histology is presented in **Fig. 6**. Distributions for malignant and non-malignant tumors are presented in **Fig. 7** and **Fig. 8**, respectively. Distribution and incidence by histology is also presented in **Table 3**.

- Overall, the most common tumor site was the meninges, representing 38.4% of all tumors.
- Frontal (7.9%), temporal (5.8%), parietal (3.4%), and occipital lobes (0.9%) accounted for 18% 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 17.9% of all tumors.
- The most frequently reported histology overall was meningioma (38.3%), followed by tumors of the pituitary (16.9%) and glioblastoma (14.5%).
- Tumors of the pituitary and nerve sheath tumors combined accounted for slightly more than one-fourth of all tumors (25.5%), the vast majority of which were non-malignant.
- For malignant tumors, frontal (24.3%), temporal (17.5%), parietal (10.4%), and occipital (2.6%) accounted for 54.8% of tumors (**Fig. 7**).
- The most common of all malignant CNS tumors was glioblastoma (48.6%).
- For non-malignant tumors, 53.9% of all tumors occurred in the meninges (**Fig. 8C**).
- The most common histology among non-malignant tumors was meningioma (53.9%).
- The most common non-malignant nerve sheath tumor (based on multiple sites in the brain and other CNS) was schwannoma (defined by histology code 9560). These tumors can occur in many sites (Supplementary Figure 6), but most commonly occur on the acoustic nerve, where they are called vestibular schwannoma (also formerly called acoustic neuromas) (74.7% of all nerve sheath 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.
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.

Fig. 5 Distribution[a] of Primary Brain and Other CNS Tumors by Behavior (Five-Year Total=415,411; Annual Average Cases=83,082), CBTRUS Statistical Report: US Cancer Statistics - NPCR and SEER, 2013-2017



** 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 (T table 2).*
a. Percentages may not add up to 100% due to rounding.
b. Includes all histologies with frequency < 1.5%, including: pilocytic astrocytoma, unique astrocytoma variants, oligodendroglioma, anaplastic oligodendroglioma, oligoastrocytic tumors, 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, cysts and heterotopias, craniopharyngioma, hemangioma, and all other (Table 2).

Fig. 6 Distribution[a] of All Primary Brain and Other CNS Tumors (Malignant and Non-Malignant Combined; Five-Year Total=415,411; Annual Average Cases=83,082), by A) Site and B) Histology, CBTRUS Statistical Report: US Cancer Statistics - NPCR and SEER, 2013-2017

Distribution of brain and other CNS tumors by site and histology for males and females are presented in Supplementary Figure 7 and Supplementary Figure 8, respectively.

Distribution of Gliomas by Site and Histology

The broad category glioma (ICD-O-3 histology codes 9380-9384, 9391-9460, see **Table 2** for more information) represented approximately 25.1% of all primary brain and other CNS tumors and 80.8% of malignant tumors. The distribution of gliomas by site and histology are presented in **Fig. 9A** and **Fig. 9B**, respectively.

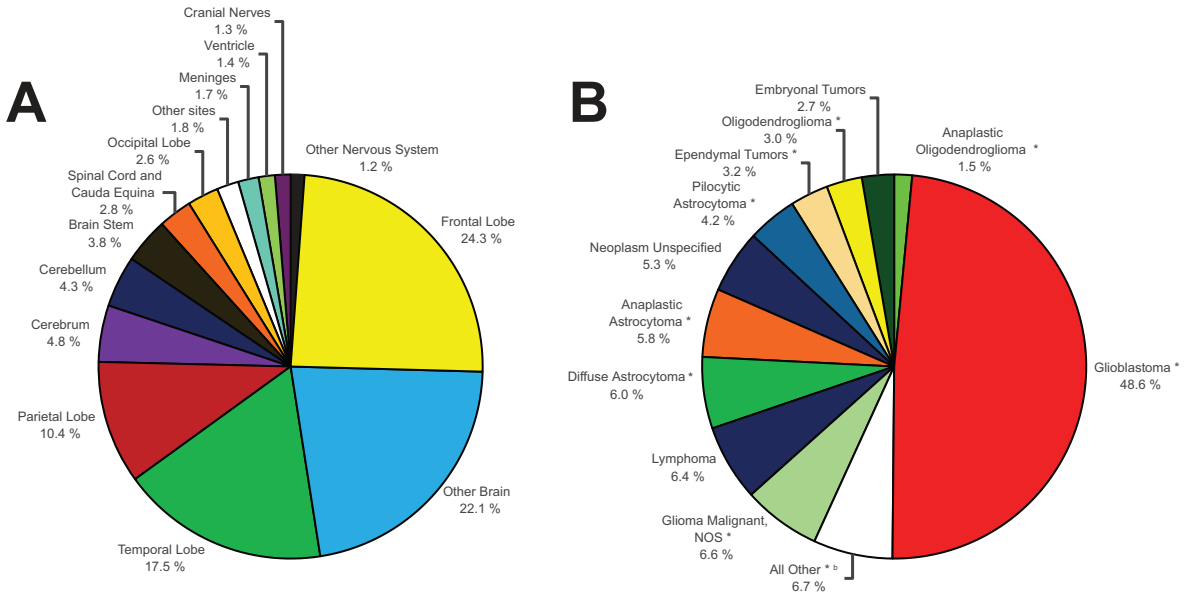
- The majority of gliomas occurred in the supra-tentorium (frontal, temporal, parietal, and occipital lobes combined) (61.4%). Only a very small proportion of gliomas occurred in areas of the CNS other than the brain (i.e. the spinal cord).
- Glioblastoma accounted for the majority of gliomas (57.7%).

Incidence Rates by Major Histology Grouping, Specific Histologies, and Behavior

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

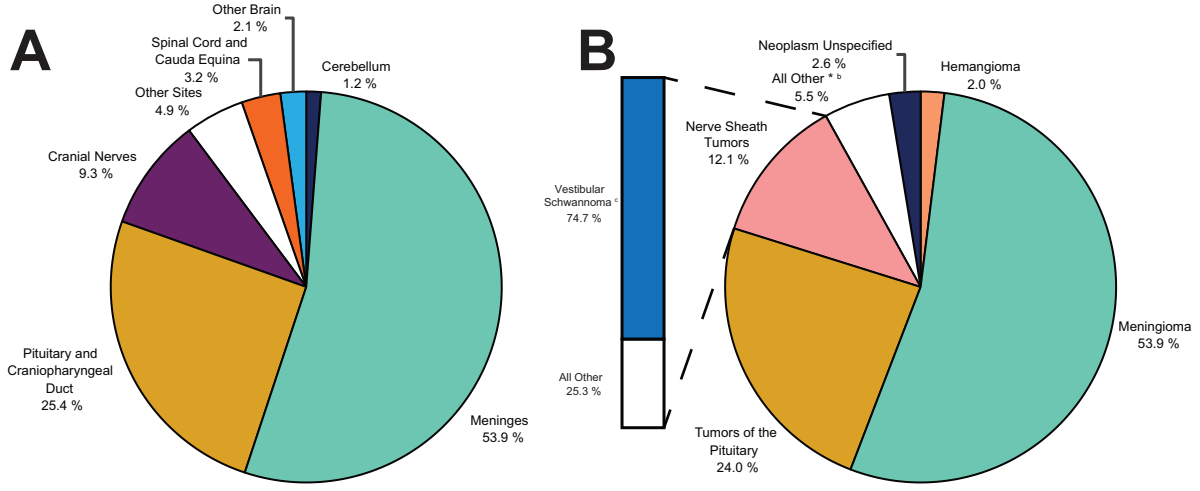
- Among CBTRUS major histology groupings, incidence rates were highest for tumors of the meninges (9.09 per 100,000 population) followed by tumors of the neuroepithelial tissue (6.56 per 100,000 population), tumors of the sellar region (4.39 per 100,000 population), and tumors of the cranial and spinal nerves (2.03 per 100,000 population).
- Among CBTRUS specific histology groupings, incidence rates were highest for meningiomas (8.81 per 100,000 population), tumors of the pituitary (4.20 per 100,000 population), glioblastomas (3.23 per 100,000 population), and nerve sheath tumors (2.03 per 100,000 population).
- For malignant tumors, the incidence rate was highest for glioblastoma (3.23 per 100,000 population), followed by glioma malignant, NOS (0.51 per 100,000), diffuse astrocytoma (0.45 per 100,000 population) and lymphoma (0.43 per 100,000 population).
- For non-malignant tumors, the incidence rate was highest for non-malignant meningioma (8.72 per 100,000 population), followed by non-malignant tumors of the pituitary (4.19 per 100,000 population).

Incidence rates for selection non-malignant histologies overall, by sex, age groups, race, and ethnicity are presented in **Table 4**, including vestibular schwannoma, pituitary adenoma, WHO grade I meningioma, and WHO grade II meningioma. These histologies are subsets of histologies presented in the overall CBTRUS histology grouping scheme (nerve sheath tumors, tumors of the pituitary, and meningioma) but are presented here due to particular clinical interest in these subgroups.



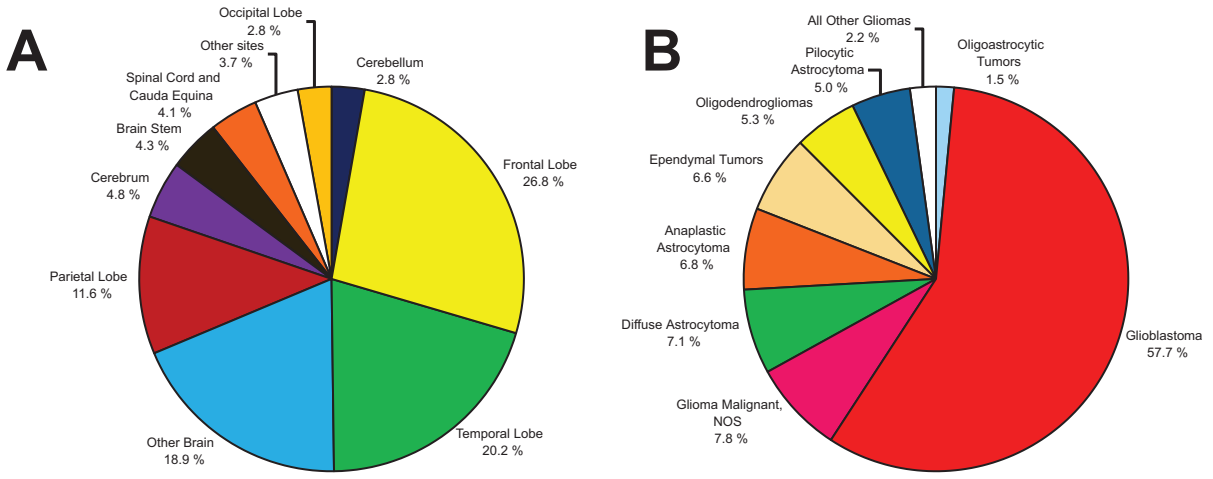
** All or some of this histology is included in the CBTRUS definition of gliomas, including ICD-O-3 histology codes 9380-9384 and, 9391-9460 (Table 2).*
a. Percentages may not add up to 100% due to rounding.
b. Includes all histologies with frequency < 1.5%, including: unique astrocytoma variants, oligoastrocytic tumors, choroid plexus tumors, other neuroepithelial tumors, neuronal and mixed neuronal glial tumors, tumors of the pineal region, nerve sheath tumors, meningioma, mesenchymal tumors, primary melanocytic lesions, other neoplasms related to the meninges, other hematopoietic neoplasms, germ cell tumors, cysts and heterotopias, tumors of the pituitary, craniopharyngioma, hemangioma, and all other (Table 2).

Fig. 7 Distribution[a] of Malignant Primary Brain and Other CNS Tumors (Five-Year Total=123,484; Annual Average Cases=24,697), by A) Site and B) Histology, CBTRUS Statistical Report: US Cancer Statistics - NPCR and SEER, 2013-2017



** 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 (T able 3).*
a. Percentages may not add up to 100% due to rounding.
b. Includes all histologies with frequency < 1.5%, including: unique astrocytoma variants, anaplastic oligodendroglioma, oligoastrocytic tumors, ependymal tumors, 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, cysts and heterotopias, craniopharyngioma, and all other. (Table 2).
c. ICD−O−3 Histology Code: 9560, with ICD−O−3 behavior code of /0 and ICD-O-3 topography code C72.4 and C72.5.

Fig. 8 Distribution[a] of All Non-Malignant Primary Brain and Other CNS Tumors (Five-Year Total=291,927; Annual Average Cases=58,385), by A) Site and B) Histology, CBTRUS Statistical Report: US Cancer Statistics - NPCR and SEER, 2013-2017



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. 9 Distribution[a] of Primary Brain and Other CNS Gliomas[b] (Five-Year Total=104,103; Annual Average Cases=20,821) by A) Site and B) Histology Subtypes, CBTRUS Statistical Report: US Cancer Statistics - NPCR and SEER, 2013-2017

Distributions and Incidence by Age

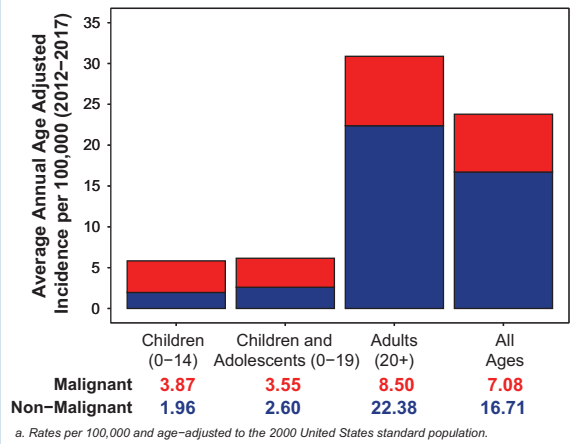
Incidence Rates by Age

The overall AAAIR for 2013-2017 for all primary brain and other CNS tumors was 23.79 per 100,000 population (**Table 3**). The overall incidence rate was 5.83 per 100,000 population for children age 0-14 years, 11.54 per 100,000 population for adolescents and young adults age 15-39 years, and 42.85 per 100,000 population for adults age 40+ years (**Table 5**). The overall incidence rates of tumors by behavior and age group (age 0-14 years, 0-19 years and 20+ years) are presented in **Fig. 10**. AAAIR stratified by sex are presented in Supplementary Figure 9.

Incidence Rates by Age and Histology

The age-adjusted incidence rates by age and histology at diagnosis are presented in Tables 5-7 as well as in **Fig. 11A** (Age 0-19 Years), and **Fig. 11B** (Age 20+ Years).

- The incidence rate for all brain and other CNS tumors was highest among age 85+ years (86.27 per 100,000 population) and lowest among children and adolescents age 0-19 years (6.14 per 100,000 population).
- Incidence rates of pilocytic astrocytoma, germ cell tumors, and embryonal tumors were higher in the younger age groups and lower with in older age group.
- 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) and medulloblastoma).



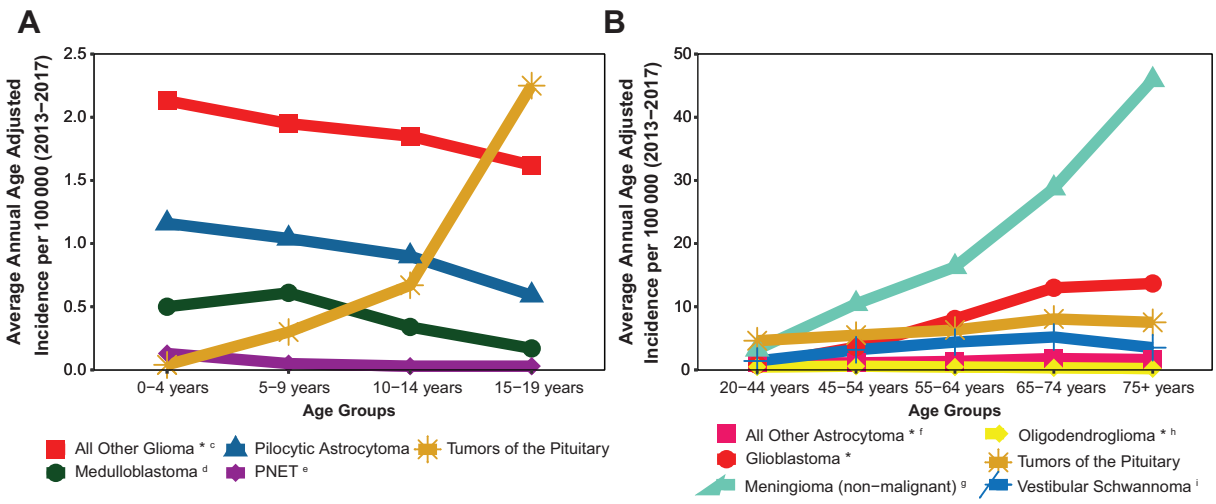
a. Rates per 100,000 and age–adjusted to the 2000 United States standard population.

Fig. 10 Average Annual Age-Adjusted Incidence Rates[a] of Primary Brain and Other CNS Tumors by Age and Behavior, CBTRUS Statistical Report: US Cancer Statistics - NPCR and SEER, 2013-2017

Median Age at Diagnosis

The median age for all primary brain and other CNS tumors by histology is presented in **Table 3**. The overall median age at diagnosis was 60 years.

- The histology-specific median ages ranged from 9 years for Embryonal Tumors to 70 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



** 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: 9380–9384, 9391–9420, 9422–9460, and 9480, all ICD–O–3 behavior codes.
d. ICD–O–3 Histology Codes: 9470, 9471, 9472, and 9474, with ICD–O–3 behavior code of /3.
e. ICD–O–3 Histology Code: 9473, with ICD–O–3 behavior code of /3.
f. ICD–O–3 Histology Codes: 9381, 9384, 9424, 9400, 9401, 9410, 9411, and 9420, all ICD–O–3 behavior codes.
g. 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.
h. ICD–O–3 Histology Codes: 9450, 9451, and 9460, with ICD–O–3 behavior code of /3.
i. ICD–O–3 Histology Code: 9560, with ICD–O–3 behavior code of /0 and ICD-O-3 topography code C72.4 and C72.5.

Fig. 11 Age-Adjusted Incidence Rates[a] of Brain and Other CNS Tumors by Selected Histologies and Age Group a) Age 0-19 Years[b], B) Age 20+ Years[b] and CBTRUS Statistical Report: US Cancer Statistics - NPCR and SEER, 2013-2017

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, 42% of all tumors diagnosed between 2013 and 2017 occurred in males (173,641 tumors) and 58% in females (241,770 tumors) (**Table 3**).
- Approximately 56% of the malignant tumors occurred in males (68,578 tumors between 2013 and 2017) and 44% in females (54,906 tumors between 2013 and 2017).
- Approximately 36% of the non-malignant tumors occurred in males (105,063 tumors between 2013 and 2017) and 64% in females (186,864 tumors between 2013 and 2017).

Incidence Rates by Site and Sex

Incidence counts and average annual age-adjusted rates for brain and other CNS tumors by site and sex are presented in **Table 8**.

- Incidence rates were highest for tumors located in the meninges (8.84 per 100,000 population) and lowest for olfactory tumors of the nasal cavity (0.04 per 100,000 population).
- Incidence rates were higher in females than in males for tumors located in the meninges, pituitary and craniopharyngeal duct, and cranial nerves, while males had higher incidence rates for tumors located in most other locations.

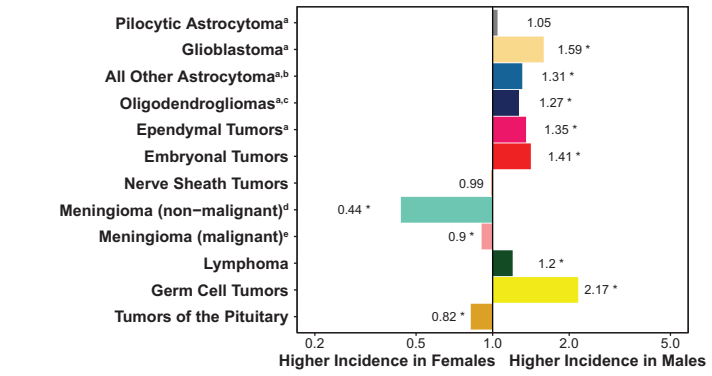
Incidence Rates by Sex and Histology

Incidence rates by sex and histology are presented in **Table 3**. Incidence rates for all primary brain and other CNS tumors combined were higher among females (26.31 per 100,000 population) than males (21.09 per 100,000 population).

- The incidence rate of tumors of neuroepithelial tissue was higher in males (7.71 per 100,000 population) than in females (5.55 per 100,000 population).
- The incidence rate of tumors of meninges was higher in females (12.22 per 100,000 population) than in males (5.56 per 100,000 population).

Average annual age-adjusted incidence rates and incidence rate ratios (male:female) for selected histologies and histology groupings are presented in Supplementary Figure 10 and **Fig. 12**, respectively.

- Incidence was higher in males for many histologies, such as germ cell tumors ($p<0.0001$), most glial tumors, lymphomas ($p<0.0001$), and embryonal tumors ($p<0.0001$).
- In addition to non-malignant ($p<0.0001$) and malignant ($p=0.0448$) meningiomas, tumors of the pituitary ($p<0.0001$) were also more common in females than in males.



** 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 2).
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. 12 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, 2013–2017

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

The overall number of reported tumors are 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 was not performed).

- Approximately 70.3% of tumors were non-malignant, but there was variation by cancer registry (range: 56.3%-80.0%).
- Overall, 55.3% of tumors were histologically confirmed. A larger proportion of malignant tumors were histologically confirmed (84.3%) compared to non-malignant tumors (43.0%).
- A slight majority of non-malignant brain and other CNS tumors were radiographically confirmed (53.7%).

The overall average annual age-adjusted incidence rates by age, behavior, and CCR are presented in **Tables 9 and 10** and **Fig. 13**. Incidence rates for all primary brain and other CNS tumors combined are presented in Supplementary Figure 11.

- There was less variation by region for malignant tumor incidence rates (**Fig. 13A**) compared to incidence rates for non-malignant tumors (**Fig. 13B**). CCR and regional variations likely reflect differences in reporting and case ascertainment practices, including state-level adoption of computer-aided registration and data linkages.
- The overall AAAIR of all tumors (malignant and non-malignant) for each individual CCR ranged from 17.9 to 38.4 per 100,000 population.
- AAAIR of all primary malignant tumors ranged from 4.71 to 8.37 per 100,000 population, and AAAIR of all primary non-malignant tumors ranged from 10.64 to 30.98 per 100,000 population.
- Among adults 20 years of age and older, CCR-specific incidence rates ranged from 5.94 to 10.01 per 100,000 population for malignant tumors and from 14.44 to 42.22 per 100,000 population for non-malignant tumors.
- In persons less than 20 years of age, incidence rates ranged from 1.64 to 4.62 per 100,000 population for malignant tumors and from 1.2 to 4.08 per 100,000 population for non-malignant tumors.

Distribution by Histology, WHO Grade Completeness, Diagnostic Confirmation, and Treatment Completeness

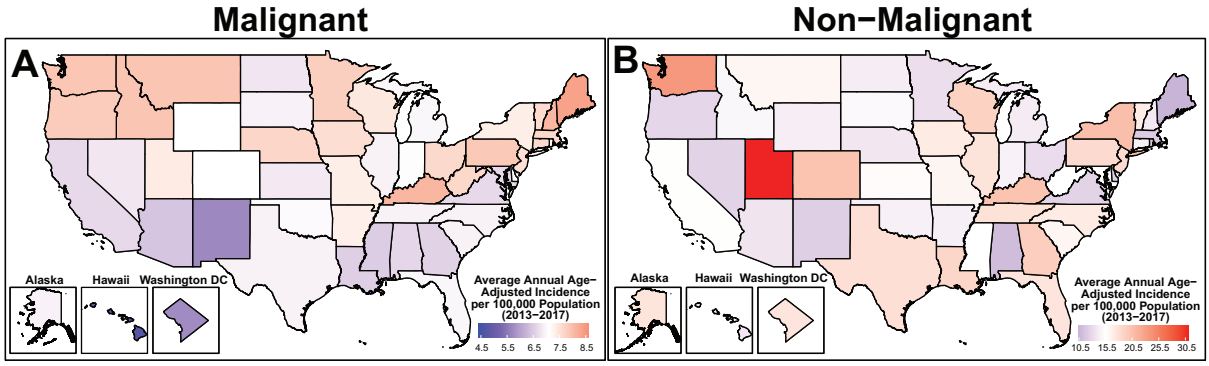
The distribution of reported tumors with histologically confirmed diagnosis from 2013 to 2017 is presented by histology and reported WHO grade in **Table 11**.

- 65.2% 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 (93.7%), anaplastic astrocytoma (95.7%), and oligoastrocytic Tumors (94.8%).

Incidence by Urban or Rural Residence at Time of Diagnosis

Incidence counts and average annual age-adjusted rates for brain and other CNS tumors are presented by urban/rural residence and histology in Supplementary Table 9. Incidence of selected histologies by urban/rural residence is presented in **Figure 14**.

- Overall incidence of brain and other CNS tumors was 11.7% higher in urban areas as compared to rural areas (23.78 per 100,000 and 21.29 per 100,000, respectively, p<0.0001).
- Incidence of malignant brain and other CNS tumors was slightly higher in urban areas (6.95 per 100,000) as compared to rural areas (6.89 per 100,000, p=0.2936).



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

Fig. 13 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, 2013-2017

- Incidence of non-malignant brain and other CNS tumors was 17% higher in urban areas as compared to rural areas (16.84 per 100,000 and 14.4 per 100,000, respectively, p<0.0001).
- Incidence of glioblastoma (2.1%, p=0.0715) was higher in urban as compared to rural areas.
- Predominantly non-malignant histologies were primarily diagnosed more frequently in urban areas, including meningioma (8.91% higher, p<0.0001), nerve sheath tumors (2.05% higher, p<0.0001), and tumors of the pituitary (4.25% higher, p<0.0001).

Distribution of Tumors in Puerto Rico

The distribution of brain and other CNS tumors diagnosed among residents of Puerto Rico by histology is presented in Supplementary Figure 12.

- Approximately 38.3% of tumors were malignant, and 61.7% were non-malignant.
- Non-malignant meningioma was the most common tumor type (26%), followed by glioblastoma (17.9%).

Incidence Rates by Race and Histology

Incidence rates by race and histology are presented in **Table 12**.

- Incidence rates for all primary brain and other CNS tumors combined were lower for race-groups AIAN (14.23 per 100,000 population) compared to Whites (23.83 per 100,000 population), Blacks (23.88 per 100,000 population), and API (15.04 per 100,000 population).
- Incidence rates for non-malignant primary brain and other CNS tumors were highest in Blacks (19.45 per 100,000) compared to Whites (16.25 per 100,000), AIAN (10.69 per 100,000), and API (11.65 per 100,000).
- Incidence rates for malignant primary brain and other CNS tumors were highest in Whites (7.58 per 100,000) compared to Blacks (4.44 per 100,000), AIAN (3.54 per 100,000), and API (3.38 per 100,000).
- Incidence rates of meningioma, tumors of the pituitary, and craniopharyngioma observed for Blacks exceeded those observed for Whites, AIAN, and API.

Average annual age-adjusted incidence rates and incidence rate-ratios (White: Black) for selected histologies are presented in **Fig. 15** and **Fig. 16**, respectively.

- **Though overall incidence of primary brain and other CNS tumor was slightly higher in Blacks as compared to Whites, incidence of many specific histologies was significantly higher among Whites.**
- 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 2.36 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 both 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.

Average annual age-adjusted incidence rates and incidence rate ratios (White:API) for selected histologies are presented in Fig. 15 and Fig. 16, respectively.

- Incidence of glioblastoma (p<0.0001) was 2.97 times greater in Whites than in API.
- Incidence of nerve sheath tumors (p<0.0001) was 1.28 times higher in Whites than in API.

Incidence Rates by Hispanic Ethnicity and Histology

Incidence rates by Hispanic ethnicity and histology are presented in **Table 13**, and incidence rate-ratios (Non-Hispanic:Hispanic) for selected histologies are presented in Supplementary Figure 12.

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).

Fig. 14 Average Annual Age-Adjusted Incidence Rates[a] and Incidence Rate Ratios with 95% Confidence Intervals of Selected Primary Brain and Other CNS Tumor Histologies by Urban Or Rural Residence at Time of Diagnosis[b], CBTRUS Statistical Report: US Cancer Statistics - NPCR and SEER, 2013-2017

- The overall incidence rate for primary brain and other CNS tumors was 21.48 per 100,000 population among Hispanics and 24.23 per 100,000 population among non-Hispanics.
- Tumors of the pituitary and lymphoma were the only histologies that were higher in Hispanics than in non-Hispanics.

While there are several histologies 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.

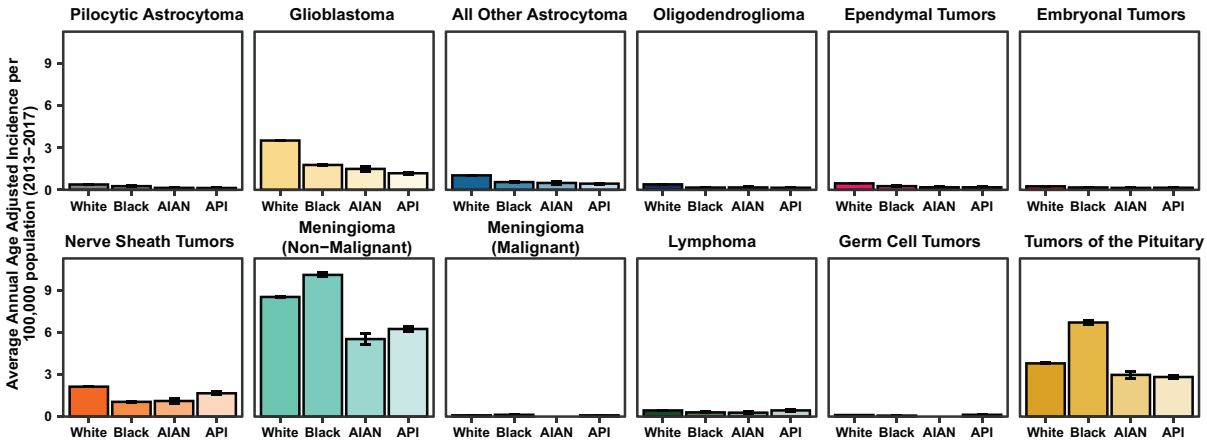
Incidence and Distribution of Primary Brain and Other CNS Tumors in Childhood and Adolescence by Site, Histology, Sex, and Age

Distribution of Tumors by Site and Histology in Children and Adolescents (Age 0-19 Years)

Brain and other CNS tumors are the most common form of solid tumors in children and account for the majority of cancer mortality in this age group. About 6% of the reported brain and other CNS tumors during 2013-2017 occurred 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 presented in **Fig. 17A**.

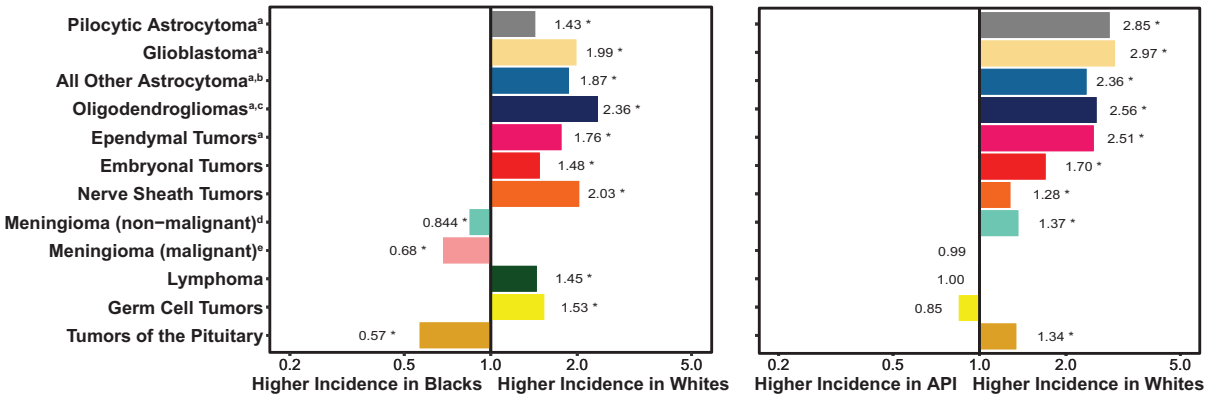
- The largest percentages of tumors in childhood and adolescence were located in the Pituitary and Craniopharyngeal duct (17%).
- Frontal, temporal, parietal, and occipital lobes of the brain accounted for 6%, 6.7%, 2.6%, and 1.2% of all brain and other CNS tumors in childhood and adolescence, respectively.
- Cerebrum, ventricle, brain stem, and cerebellum tumors accounted for 5.3%, 5.2%, 10.9%, and 13% of all brain and other CNS tumors in childhood and adolescence, respectively.
- The cranial nerves and the spinal cord and cauda equina accounted for 7.2% and 5.1% of all brain and other CNS tumors in childhood and adolescence, respectively.

The most common brain and other CNS histologies in children and adolescents age 0-19 years are presented in **Fig. 17B**.



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

Fig. 15 Average Annual Age-Adjusted Incidence Rates[a] with 95% Confidence Intervals of Selected Primary Brain and Other CNS Tumor Histologies by Race, CBTRUS Statistical Report: US Cancer Statistics - NPCR and SEER, 2013-2017



** 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 2).
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.

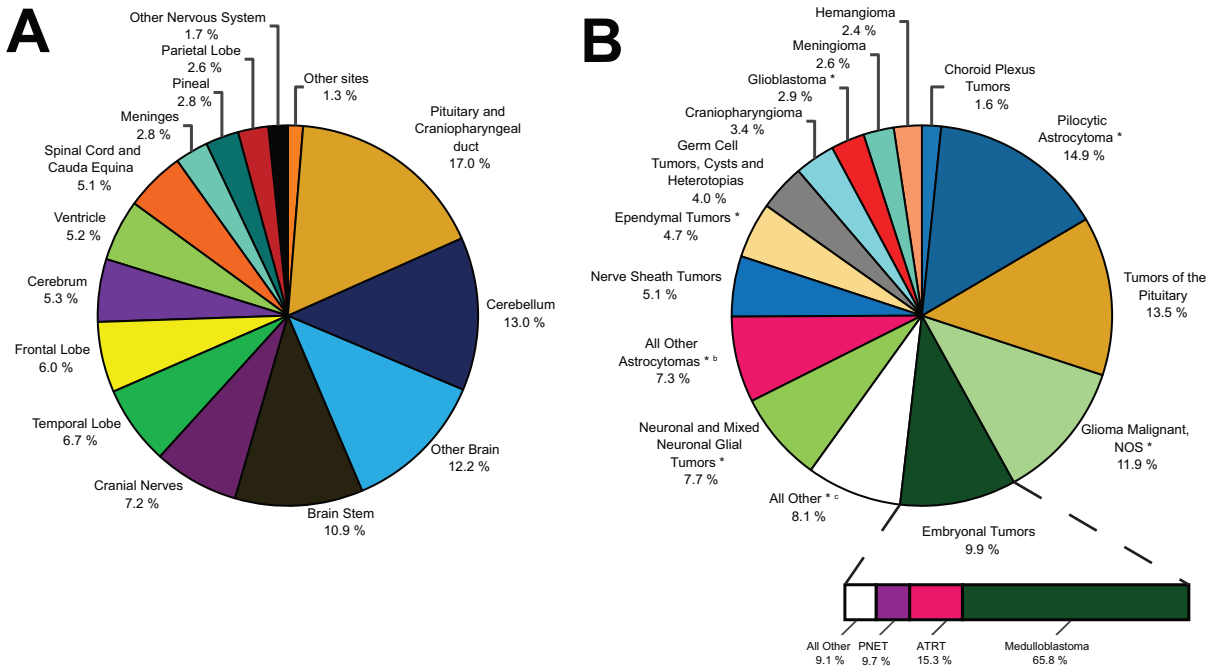
Fig. 16 Incidence Rate Ratios by Race (Whites:Blacks and Whites:Asian Or Pacific Islanders [API]) for Selected Primary Brain and Other CNS Tumor Histologies, CBTRUS Statistical Report: US Cancer Statistics - NPCR and SEER, 2013-2017

- For children and adolescents age 0-19 years, pilocytic astrocytoma, glioma malignant, NOS, and embryonal tumors accounted for 14.9%, 11.9%, and 9.9%, respectively.
- Tumors of the pituitary were the most common non-glial and predominantly non-malignant histology and accounted for 13.5% of all tumors in this age group.
- Gliomas accounted for approximately 45.5% of tumors in children and adolescents age 0-19 years.
- Medulloblastoma accounted for 65.8% of all embryonal tumors in this age group.

Distribution of Tumors by Site and Histology in Children (Age 0-14 Years)

Approximately 4.3% of all reported tumors occurred in children age 0-14 years. The distribution of brain and other CNS tumors for children age 0-14 years is presented by site and histology in **Fig. 18A** and **Fig. 18B**, respectively.

- Tumors of cerebellum (15.3%) comprised the largest proportion of tumors followed by the other brain (14.2%) and brain stem (13.3%).



** 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 all histologies with frequency <1.5%, including: oligodendrogliomas, oligoastrocytic tumors, lymphoma, 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, neoplasm unspecified, and all other (Table 2).

Fig. 17 Distribution[a] in Children and Adolescents (Age 0-19 Years) of Primary Brain and CNS Tumors (Malignant and Non-Malignant Combined; Five-Year Total=25,105; Annual Average Cases=5,021) by A) Site and B) Histology, CBTRUS Statistical Report: US Cancer Statistics - NPCR and SEER, 2013-2017

- For children age 0-14 years, pilocytic astrocytoma, glioma malignant, NOS, and embryonal tumors accounted for 17.7%, 14.5%, and 12.7%, respectively.
- Gliomas accounted for approximately 51.6% of tumors in children age 0-14 years.
- Of embryonal tumors, medulloblastoma, atypical teratoid rhabdoid tumor (ATRT), and primitive neuroectodermal tumor (PNET) accounted for 64.7%, 16.6%, and 9.5%, respectively.

Distribution of Tumors by Site and Histology in Adolescents (Age 15-19 Years)

About 1.8% of the reported brain and other CNS tumors during 2013-2017 occurred in adolescents age 15-19 years for a total of 7,432 tumors diagnosed between 2013 and 2017 (**Table 6**). The distribution of these tumors by site and histology is presented in **Fig. 19A** and **Fig. 19B**, respectively.

- 34.6% of these tumors were diagnosed in the pituitary and craniopharyngeal duct.
- The frontal lobe, temporal lobe, occipital lobe, and parietal lobe accounted for 19.2% of tumors in this age group.
- The most common histology in adolescents was tumors of the pituitary (31.8%).
- Gliomas accounted for approximately 31.1% 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)

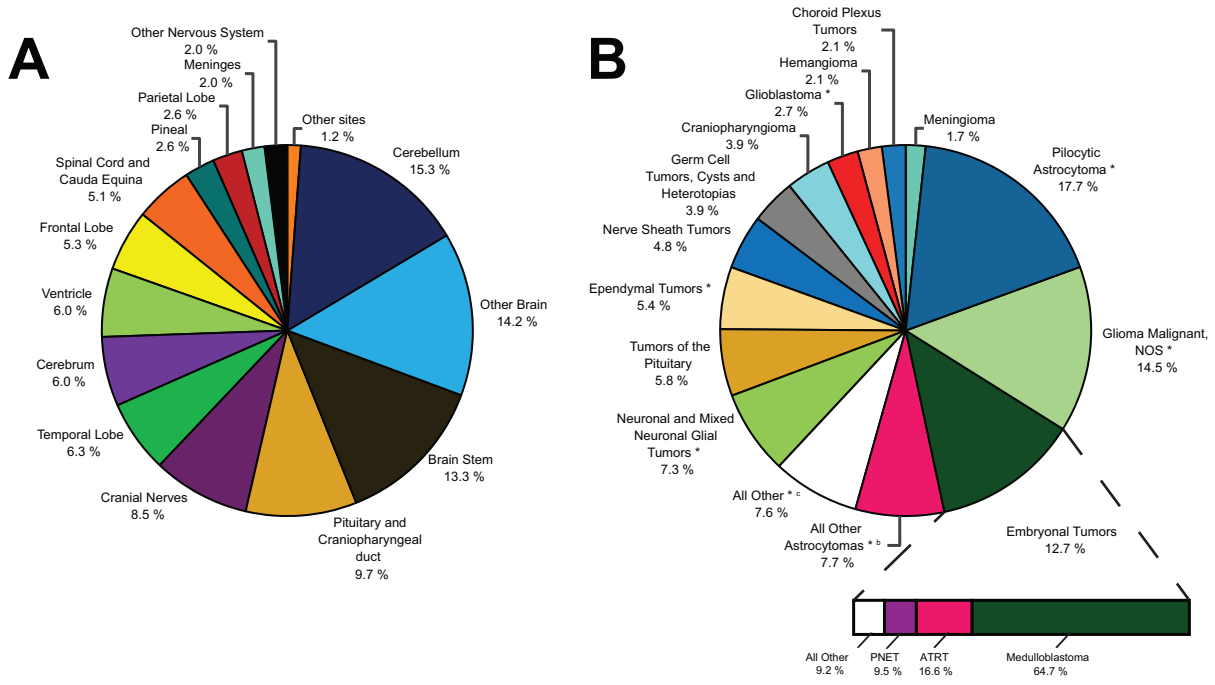
The incidence rates of the most common brain and other CNS tumors in children and adolescents by major histology grouping, histology, and sex are presented in **Table 14**.

- Average annual incidence rates were highest for tumors of neuroepithelial tissue (3.88 per 100,000 population). Among these tumors, the most common histologies were pilocytic astrocytoma (0.92 per 100,000 population), glioma malignant, NOS (0.73 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/Ethnicity in Children and Adolescents (Age 0-19 Years)

Incidence rates for brain and other CNS tumors by histology and race for children and adolescents age 0-19 years are presented in **Table 15** and by race/ethnicity in **Table 16**.

- Incidence rates were highest among White (6.36 per 100,000 population) compared to Blacks (4.83 per 100,000 population), AIAN (3.22 per 100,000 population), and API (3.48 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 (T able 3).
c. Includes all histologies with frequency < 1.5%, including: oligodendrogliomas, oligoastrocytic tumors, lymphoma, 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, neoplasm unspecified, and all other(Table 2).

Fig. 18 Distribution[a] in Children (Age 0-14 Years) of Primary Brain and Other CNS Tumors (Malignant and Non-Malignant Combined; Five-Year Total=17,673; Annual Average Cases=3,535) by A) Site and B) Histology, CBTRUS Statistical Report: US Cancer Statistics - NPCR and SEER, 2012-2016

Incidence Rates by Age and Histology in Children and Adolescents (Age 0-19 Years)

Detailed age-adjusted incidence rates 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 presented in **Table 6**.

- Overall, incidence rates for age groups 0-4 years (6.18 per 100,000 population) and 15-19 years (7.09 per 100,000 population) exceeded those observed in age groups 5-9 years (5.49 per 100,000 population) and 10-14 years (5.83 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.

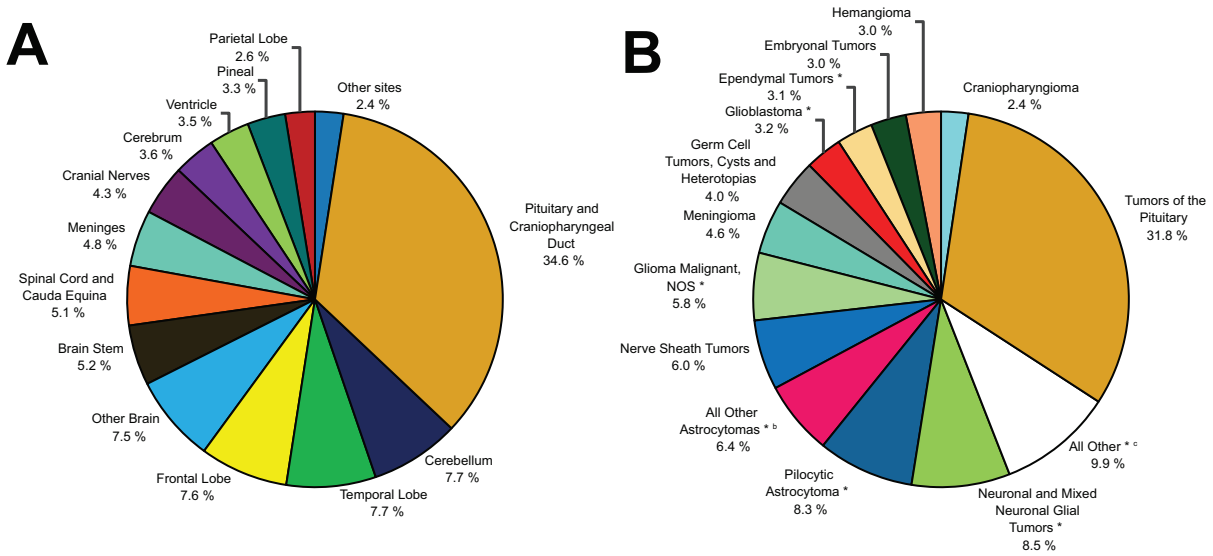
Incidence Rates by Histology Defined by ICCC in Children and Adolescents (Age 0-19 Years)

The CBTRUS brain and other CNS tumor data for children and adolescents used for this report according to the International Classification of Childhood Cancer (ICCC) grouping system for pediatric cancers are presented in Supplementary Table 8 (See Supplementary Table 1 for more additional information on the ICCC classification scheme).

Incidence and Distribution of Primary Brain and Other CNS Tumors in Adolescent and Young Adults (Age 15-39 Years)

About 14.5% of the reported brain and other CNS tumors during 2013-2017 occurred in adolescents and young adults age 15-39 years for a total of 60,358 tumors diagnosed between 2013 and 2017 (**Table 5**). The distribution of these tumors by site and histology is presented in **Fig. 20A** and **Fig. 20B**, respectively.

- The overall incidence rate in this age group was 11.54 per 100,000 population (**Table 5**). Incidence of malignant tumors was 3.23 per 100,000, and incidence of non-malignant tumors was 8.31 per 100,000.
- Tumors of the sellar region had the highest incidence (4.07 per 100,000 population), followed by tumors of the neuroepithelial tissue (3.46 per 100,000 population) (**Table 5**).
- The most common histology in AYA was tumors of the pituitary (3.94 per 100,000 population), followed by meningioma (1.89 per 100,000 population) and nerve sheath tumors (1.05 per 100,000 population) (**Table 5**).



** 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 all histologies with frequency < 1.5%, including: oligodendrogliomas, oligoastrocytic tumors, lymphoma, 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, neoplasm unspecified, and all other(Table 2).

Fig. 19 Distribution[a] in Adolescents (Age 15-19 Years) of Primary Brain and Other CNS Tumors (Malignant and Non-Malignant Combined; Five-Year Total=7,432; Annual Average Cases=1,486) by A) Site and B) Histology, CBTRUS Statistical Report: US Cancer Statistics - NPCR and SEER, 2013-2017

- The majority of AYA brain and other CNS tumors occurred in the pituitary and craniopharyngeal duct (36.1%), followed by the meninges (15.9%) (**Fig. 20A**).
- Approximately 17.6% of tumors diagnosed in AYA were located within the frontal, temporal, parietal, and occipital lobes of the brain combined (**Fig. 20A**).
- Cerebrum, ventricle, cerebellum, and brain stem tumors combined accounted for about 6.3% of all AYA tumors (**Fig. 20A**).
- The predominately non-malignant tumors of the pituitary (28%), meningioma (12.5%), and nerve sheath (8%) represented over half of CNS tumors diagnosed in AYA (**Fig. 20B**).
- Glioma accounted for approximately 25.6% of all brain and other CNS tumors in AYA, and about 82.4% of all malignant tumors (**Fig. 20B**).

Estimated Numbers of Expected Cases Primary Brain and Other CNS Tumors

Estimated Numbers of Expected Cases of All Primary Brain and Other CNS Tumors by State

The estimated number of cases of all primary brain and other CNS tumors for 2020 and 2021 by State and Behavior are presented in **Table 17**. Overall totals presented are based on total malignant and nonmalignant incidence, and it should be noted that these 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 equal the total estimate presented. Therefore, caution should be used when utilizing these estimates.

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 2020 and 2021 by histology and age are presented in **Table 18** and Supplementary Table 10. Overall totals presented are based on total malignant and non-malignant incidence, and it should be noted that these 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 equal the total estimate presented. Therefore, caution should be used when utilizing these estimates.

- The total number of new cases of primary brain and other CNS tumors in 2020 is estimated to be 83,830, with 24,970 malignant and 58,860 non-malignant cases.
- For 2021, the estimate is 84,170 new cases of primary brain and other CNS tumors of which 25,130 and 59,040 are expected to be malignant and non-malignant, respectively.
- Meningiomas have the highest number of all estimated new cases, with 34,300 cases projected in 2020 and 34,840 in 2021

- Glioblastoma has the highest number of cases of all malignant tumors, with 12,800 cases projected in 2020 and 12,970 in 2021.
- For 2020, the highest number of new cases is predicted in those age 65+ years, with 38,000 cases. For 2021, the highest number of new cases is estimated to be in those age 65+ years, with 38,900 cases.
- For 2020 and 2021, children age 0-14 years are estimated to have 3,440 and 3,460 new cases of primary brain and other CNS tumors each year, respectively.
- For 2020 and 2021, children age 0-19 years are estimated to have 4,620 and 4,630 new cases of primary brain and other CNS tumors each year, respectively.
- AYA are estimated to have 11,720 new primary brain and other CNS tumors in 2020 and 11,700 in 2021 (Supplementary Table 10).

Mortality Rates

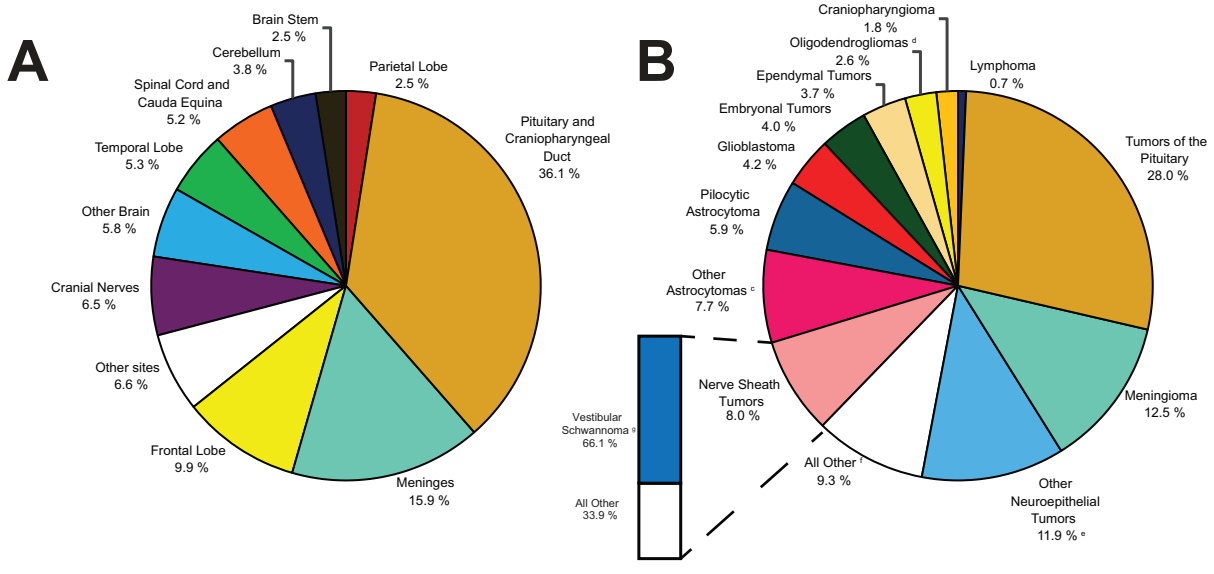
Mortality Rates for Malignant Brain and Other CNS Tumors by State, Sex, and Urban/Rural Residence

AAAMR for primary malignant brain and other CNS tumors in the US during 2013-2017 by state and sex are presented in **Table 19** and **Fig. 21**. AAAMR for primary malignant brain and other CNS tumors by state and urban/rural residence are presented in Supplementary Table 11.

- The aggregate total number of observed deaths was 81,246, for an AAAMR rate of 4.42 per 100,000 population.
- There was considerable variation by individual state, which ranged from a low of 2.28 deaths per 100,000 population to a high of 5.76 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 5.36 per 100,000 population as compared to 3.61 per 100,000 population.
- Mortality rates for malignant brain and other CNS tumors were higher in rural areas (4.7 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 2.28 per 100,000 population to 6.22 per 100,000 population, and mortality rates in rural areas ranged from 3.43 per 100,000 population to 5.79 per 100,000 population.

Estimated Incidence-Based Mortality Rates for Malignant Brain and Other CNS Tumors by Histology

Average annual age-adjusted incidence-based mortality rates for malignant primary brain and other CNS tumors by histology and behavior in the US during 2008-2017 in the SEER 9 registries are presented in **Table 20**. Please see the methods section for details on how these rates were calculated.



** 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: http://www.cancer.gov/researchandfunding/snapshots/adolescent-young-adult.
c. Includes diffuse astrocytoma, anaplastic astrocytoma, and unique astrocytoma variants (Table 2).
d. Includes oligodendrogliomas and anaplastic oligodendrogliomas (Table 2).
e.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).
f. 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).
g. ICD−O−3 Histology Code: 9560, with ICD−O−3 behavior code of /0 and ICD-O-3 topography code C72.4 and C72.5.

Fig. 20 Distribution[a] in Adolescents and Young Adults[b] (Age 15-39 Years) of Primary Brain and Other CNS Tumors (Five-Year Total=60,358; Annual Average Cases=12,072) by A) Site and B) Histology, CBTRUS Statistical Report: US Cancer Statistics - NPCR and SEER, 2013-2017

- The largest contributor to brain tumor deaths were tumors of neuroepithelial tissue (mortality rate of 4.87 per 100,000 population, 49% of total deaths).
- Tumors of the meninges represented 32.2% of all deaths due to brain and other CNS tumors (mortality rate of 4.87 per 100,000 population, 32.2% of total deaths).

Overall Survival and Relative Survival

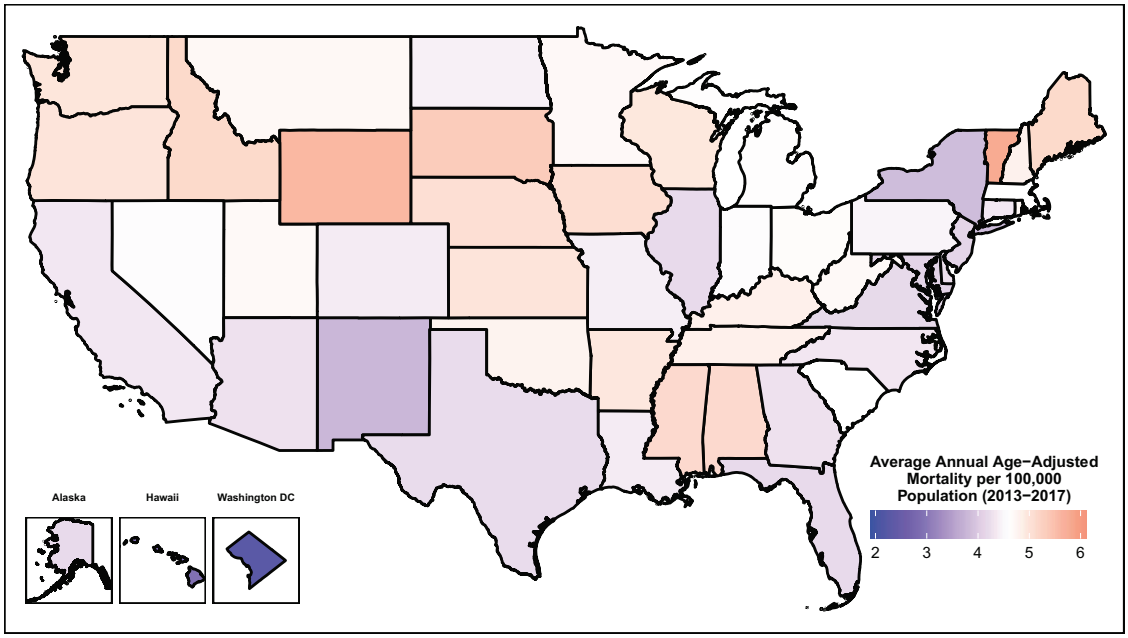
Overall Survival Rates for Primary Malignant Brain and Other CNS Tumors by Histology

Estimates of median survival in months by histology and age group for all individuals diagnosed with primary malignant brain and other CNS tumors **regardless of whether individuals received any treatment for their tumor** are presented in **Table 21**. Survival curves for the most common histologies are presented by age-group in **Fig. 22A**.

- Median survival was lowest for glioblastoma (8 months) and highest for malignant tumors of the pituitary (139 months, or approximately 11.5 years).
- Median survival was not able to be estimated for pilocytic astrocytoma, ependymal tumors, or germ cell tumors as >50% of individuals remained alive during the 15 year follow up period.
- **Many other published survival estimates (including many of those previously published by CBTRUS) incorporate treatment patterns which may explain differences between these population-level estimates and other published estimates.**

Demographic factors such as age at diagnosis, sex, race, and ethnicity are known to have a significant effect on survival time after diagnosis in primary brain and other CNS tumors. Hazard ratios for the effect of age groups, sex, race, and ethnicity are presented in **Table 22 for all individuals regardless of whether they received any treatment for their tumor**. Hazard ratio estimates for demographic factors in the five most common histologies are presented by histology in **Fig. 22B**.

- AYA had better overall survival as compared to children 0-14 years old in approximately half of the histologies evaluated, while adults 40+ years old had poorer survival.
- Older adults (40+ years old) had poorer survival than Children 0-14 years old in nearly every histology.
- Females generally had better survival outcomes as compared to males with the exception of glioblastoma, embryonal tumors, and germ cell tumors.
- Black individuals had poorer survival outcomes as compared to white individuals with the exception of glioblastoma.
- AIAN individuals had poorer survival as compared to white individuals in many histologies, though the small size of this population meant that many of these associations were non-significant.
- Being an API was associated with improved survival in many histologies as compared to Whites with the exception of choroid plexus tumors.



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

Fig. 21 Average Annual Age-Adjusted Mortality Rates[a] for Malignant Primary Brain and Other CNS Tumors by Central Cancer Registry, CBTRUS Statistical Report: NVSS, 2013-2017

- Hispanic ethnicity was associated with improved survival in most histologies.
- **Many other published survival estimates (including many of those previously published by CBTRUS[62,63]) incorporate treatment patterns which may explain differences between these population-level estimates and other published estimates.**

When interpreting these results, it is important to remember that these models do not incorporate important factors that affect survival such as treatment patterns, health insurance, or type of facility at which an individual received treatment, all of which may be associated with these demographic factors as well as overall survival.

Relative Survival Rates for Brain and Other CNS Tumors by Site and Behavior

Relative survival estimates by site and behavior are presented in Supplementary Table 12

- The highest five-year survival was for tumors occurring in the cranial nerves (99.3%).
- The lowest five-year survival was for tumors of the parietal lobe (27.7%).

Relative Survival Rates for Brain and Other CNS Tumors by Histology, Behavior and Age Groups

Relative survival estimates for brain and other CNS tumors by histology, behavior, and age at diagnosis are presented in **Table 23** and Supplementary Table 13.

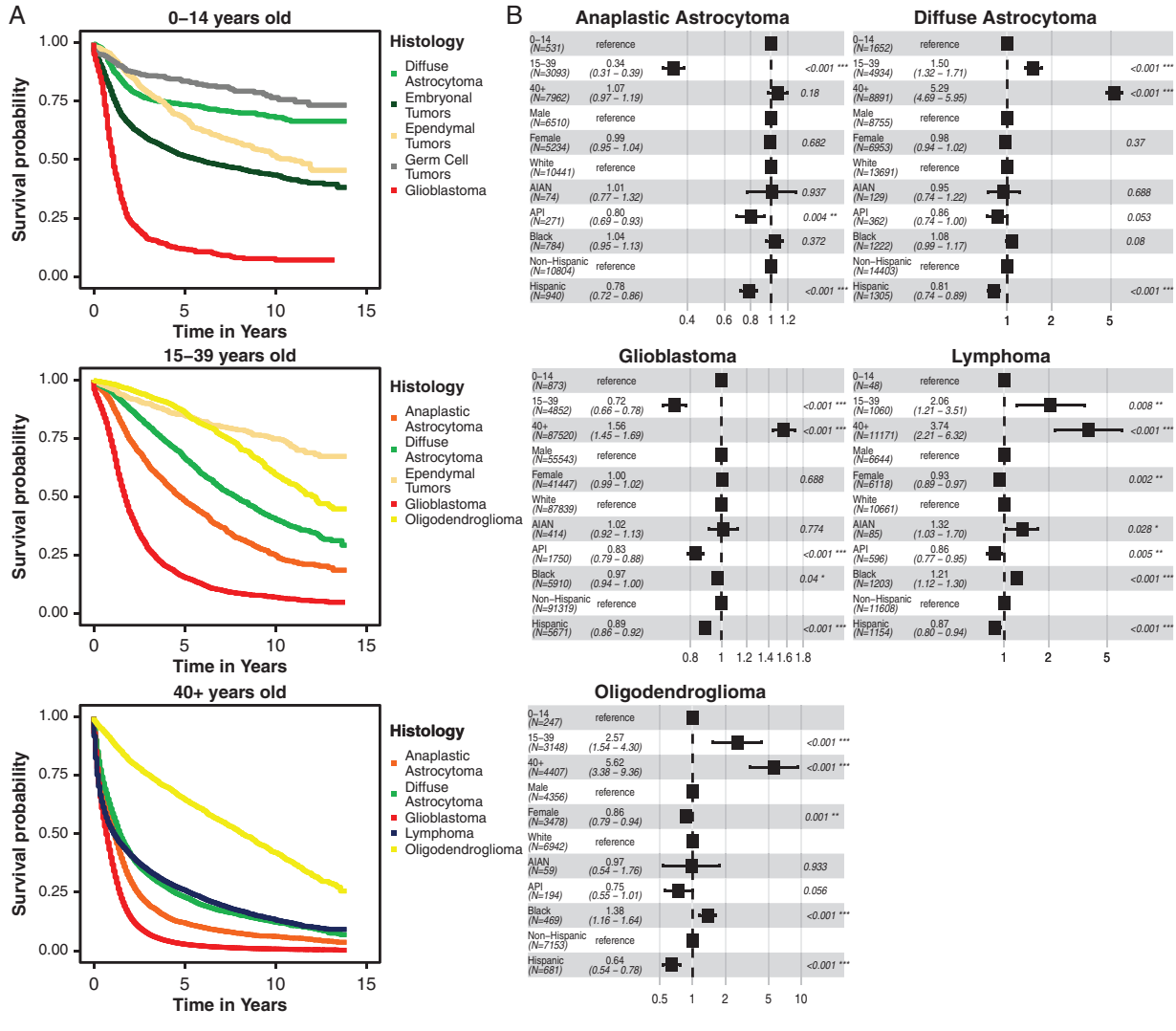


Fig. 22 A) Kaplan-Meier Survival Curves for the Five Most Common Histologies within Age Groups (Age 0-14, 15-39 and 40+) And B) Hazard Ratios And 95% Confidence Intervals for Sex, Age, Race, and Ethnicity for the Five Most Common Histologies Overall

- There was large variation in survival estimates depending upon tumor histology; five-year survival rates were 94.5% for pilocytic astrocytoma but are 7.2% for glioblastoma.
- Survival generally decreased with older age at diagnosis; children and young adults generally had better survival outcomes for most histologies.
- Among predominantly non-malignant histologies, five-year survival was lowest in craniopharyngioma and meningioma, which had five-year relative survival of 86.2% and 88.1%, respectively.
- Among predominantly non-malignant histologies, five-year survival was highest in nerve sheath tumors which had five-year relative survival of 99.3%.
- In general, relative survival in most histologies was higher in adolescents and young adults as compared to children and adults.

Relative Survival Rates for Brain and Other CNS Tumors by Histology, Behavior, and Urban/Rural Residence

Survival estimates for primary malignant and non-malignant brain and other CNS tumors are presented by urban/rural residence and selected histologies in Supplementary Table 14. Overall, one-, five-, and ten-year survival were higher in urban areas as compared to rural areas.

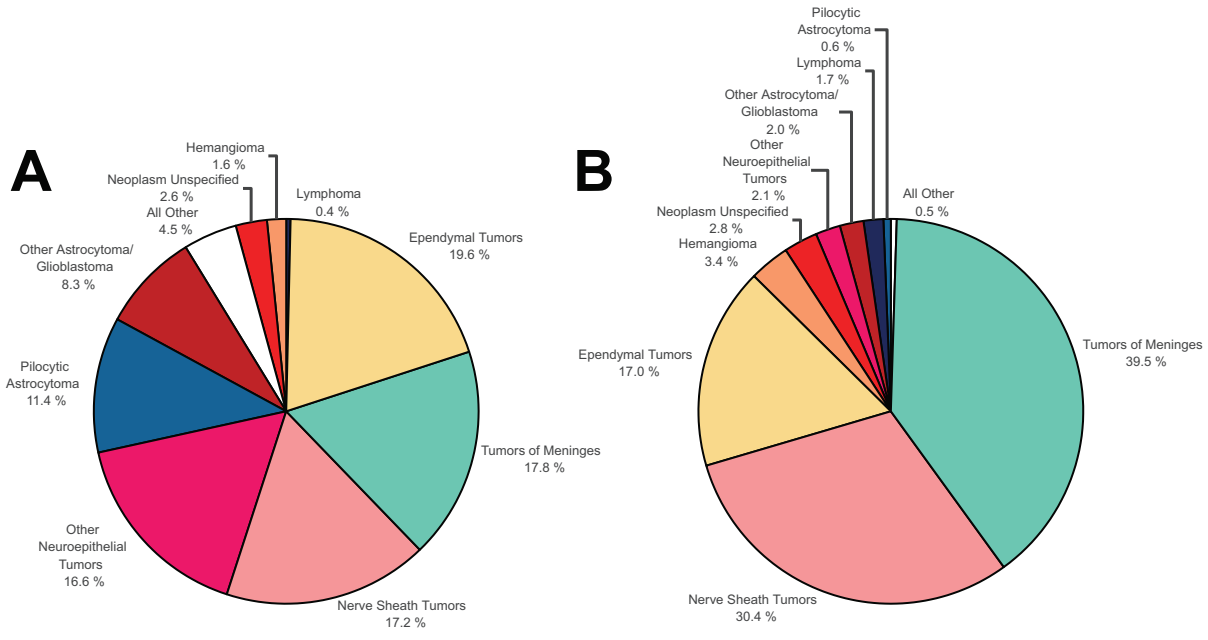
Descriptive Summary of Spinal Cord Tumors

Although spinal cord tumors account for a relatively small percentage of primary brain and other CNS tumors, they can result in significant morbidity. The most common histologies found in the spinal cord, spinal meninges, and cauda equina are presented in **Fig. 23** for both children (age 0-19 years, **Fig. 23A**) and adults (age 20+ years, **Fig. 23B**).

- The predominant histology group for those age 0-19 years was ependymal tumors (19.6%) followed by tumors of meninges (17.8%).
- Tumors of meninges (39.5%) accounted for the largest proportion of spinal cord tumors among those age 20 years and older.
- Five-year survival after diagnosis with a tumor of the spinal cord and cauda equina was 93.6%, with a ten-year relative survival of 92.1% Supplementary Table 12.

Descriptive Summary of Meningioma, Glioblastoma, and Embryonal Tumors

The data in the CBTRUS Statistical Report 2013-2017 are synthesized to describe three of the most common histologic types: **meningioma** and **glioblastoma** for adults, and **embryonal tumors** for children and adolescents.



** 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, and unique astrocytoma variants (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. 23 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=1,371; Annual Average Cases=274) and B) Adults (Age 20+ Years, Five-Year Total=18,502; Annual Average Cases=3,700), CBTRUS Statistical Report: US Cancer Statistics - NPCR and SEER, 2013-2017

Meningioma

- Meningioma was the most frequently reported brain and other CNS tumor, accounting for 38.3% of tumors overall (**Fig. 6B**).
- Most meningiomas (80.6%) were located in the cerebral meninges, 4.2% were located in the spinal meninges, and approximately 14.5% did not have a specific meningeal site listed.
- **Non-malignant** meningioma with ICD-O-3 behavior codes /0 (benign) or /1 (uncertain) accounted for 98.9% of meningiomas reported to CBTRUS (**Table 5**).
- Of meningioma with documented WHO grade (81.3%, **Table 11**), 80.3% of meningioma were WHO grade I, 17.9% were WHO grade II, and 1.6% 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 2.3 times more common in females compared to males (**Fig. 12**). 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 age 35-54 years, where incidence rates were 3.29 times higher in females (Supplementary Figure 14).
- Incidence of meningioma was significantly higher in Blacks than in Whites (**Fig. 16**).
- The median survival for **malignant** meningioma was 53 (95% CI: 48-58) months (**Table 21**). Older adults (40+ years old), Male sex, White race and non-Hispanic ethnicity had poorer survival after diagnosis of **malignant** meningioma (**Table 22**).
- Ten-year relative survival for **malignant** meningioma was 59.6% (**Table 23**). Age had a large effect on survival after diagnosis with malignant meningioma: 10-year relative survival was 74.2% for the population age 20-44 years, and 40.8% for age 75+ years (Supplementary Table 13).
- Ten-year relative survival for **non-malignant** meningioma was 87.4% (**Table 23**). Age had a large effect on survival after diagnosis with non-malignant meningioma: 10-year relative survival was 94.5% in AYA, and 81.2% in adults 40+ years old.
- Site of meningioma had an effect on relative survival after diagnosis with meningioma (Supplementary Figure 15). For **non-malignant** meningioma, 10-year relative survival was 83.5% for tumors in the cerebral meninges, but 95.8% for tumors in the spinal meninges.

Glioblastoma

- Glioblastoma was the third most frequently reported CNS histology and the most common malignant tumor overall (**Fig. 6B**).
- Glioblastoma accounted for 14.5% of all primary brain and other CNS tumors (**Fig. 7B**) and 48.6% of primary malignant brain tumors (**Fig. 8B**).
- Glioblastoma was more common in older adults (**Table 7**) and was less common in children (**Table 6**); these tumors comprised approximately 2.9% 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 1.59 times more common in males (**Fig. 12**).
- Glioblastoma was 1.99 times higher among Whites compared to Blacks (**Fig. 16**).
- The median survival for glioblastoma for **all patients (regardless of treatment)** was 8 months (95% CI: 8-9) (**Table 21**). Older adults (40+ years old), Female sex, White race and non-Hispanic ethnicity were associated with poorer survival after diagnosis of glioblastoma (**Table 22**). **Many other published survival estimates (including many of those previously published by CBTRUS[62,63]) incorporate treatment patterns which may explain differences between these population-level estimates and other published estimates.**
- Relative survival estimates for glioblastoma were quite low; 7.2% of patients survived five years post-diagnosis (**Table 23**). These survival estimates were somewhat higher for the small number of patients who were diagnosed under age 20 years (Supplementary Table 13).

Embryonal Tumors

- Embryonal tumors were the 2nd most frequently reported brain and other CNS tumor histology grouping in children age 0-4 years, and the 5th most common tumor type overall in children and adolescents age 0-19 years (**Table 6**, **Fig. 17B**).
- Embryonal tumors accounted for 12.7% of all primary brain and other CNS tumors in children age 0-14 years (**Fig. 18B**), 9.9% of tumors in children and adolescents age 0-19 years (**Fig. 17B**), and 0.90.9% of tumors diagnosed overall (**Table 3**).
- Embryonal tumors within the CBTRUS histologic grouping scheme includes multiple different histologies: PNET (ICD-O-3 histology code 9473), medulloblastoma (ICD-O-3 histology codes 9470-9472), ATRT (ICD-O-3 histology code 9508), and several other histologies (**Table 2**).
- Incidence of medulloblastoma decreased with age. Incidence was 0.5 per 100,000 population, 0.61 per 100,000 population, 0.34 per 100,000 population, and 0.17 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 PNET was 0.13 per 100,000 population, 0.05 per 100,000 population, 0.03 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 0.33 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**).
- Embryonal tumors were more common in males than females (**Fig. 13**). This difference was greatest in medulloblastoma, which occurred 1.69 times as frequently in males 0-14 years as compared to females in this age group (Supplementary Fig. 16). Incidence of ATRT and PNET in children 0-14 was not significantly different between males and females.
- The median survival for embryonal tumors was 66 (CI: 61-73) months (**Table 21**). Older adults (40+ years old), Black race and Hispanic ethnicity had poorer survival after diagnosis of embryonal tumors. (**Table 22**).

Descriptive Summary of Incidence 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 annual percentage change (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.[64] Overall, changes in incidence rates of **all primary** brain and other CNS tumors between 2000 and 2017 (limited to 2004 and 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 latter is especially applicable to the collection of non-malignant brain and other CNS tumors.

All Malignant Brain and Other CNS Tumors

Please see **Fig. 7B** for an overview of histologies included in all malignant brain and other CNS tumors.

- From 2008-2017, there was a slight decrease in overall incidence (APC=-0.8% [95%CI: -1.0%, -0.6%]), **Fig. 24**, Supplementary Table 15).
- There was a small but statistically significant increase in incidence in children (age 0-14 years, APC=0.6% [95%CI: 0.4%, 0.9%]), **Fig. 24**), a small but statistically significant decrease in AYA (age 15-39 years, APC=-0.4% [95%CI: -0.5%, -0.2%]), **Fig. 24**) from 2000-2017, and a small but statistically significant decrease in older adults from 2007-2017 (age 40+ years, APC=-0.9% [95%CI: -1.1%, -0.8%]), **Fig. 24**).

Glioma

Please see **Fig. 9B** for an overview of histologies included in the broad category of glioma.

- There was a slight increase in incidence from 2000-2007 (APC=1.1% [95%CI: 0.6%, 1.5%]), Fig. 26), followed by a small but significant decrease in incidence from 2007-2017 (APC=-0.6% [95%CI: -0.8%, -0.3%], **Fig. 25**).
- There was a significant increase in incidence in children (age 0-14 years, APC=2.2% [95%CI: 1.5%, 2.9%]) from 2000-2011, and a significant increase in incidence in AYA from 2000-2006 (age 15-39 years, APC=2.5% [95%CI: 1.0%, 3.9%]), **Fig. 25**).
- Incidence in older adults (age 40+ years) was relatively stable: there was a statistically significant increase from 2000-2007 (APC=APC=0.6% [95%CI: 0.2%, 1.1%]), followed by a statistically significant decrease from 2007-2017 (APC=0.7% [95%CI: -1.0%, -0.5%], **Fig. 25**).
- There was a small but significant increase in incidence of glioblastoma from 2000-2004 (APC=1.1% [95%CI: 0.1, 2.2]), with no significant change between 2007 and 2016 (**Fig. 25**, Supplementary Table 13).

Malignant Meningioma

- There was a statistically significant decrease in incidence from 2000-2017 (APC=-4.4% [95%CI: -5.1%, -3.7%]), Supplementary Table 15).
- 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.

All Non-Malignant Brain and Other CNS Tumors

Please see **Fig. 8B** for an overview of histologies included in all malignant brain and other CNS tumors.

- There was a significant increase in incidence of non-malignant brain tumors from 2004-2009 (APC=5.2% [95%CI: 3.5%, 7.1%]), **Fig. 24**, Supplementary Table 16), and no significant change between 2009 and 2016.
- There was a small but statistically significant increase in incidence of these tumors in children (2004-2014, APC=2.8% [95%CI: 2.0%, 3.6%]), **Fig. 24**), in AYA (2004-2009, APC=6.5% [95%CI: 3.9%, 9.1%]), Fig. 25), and older adults (2004-2009, APC=5.0% [95% CI: 3.1%, 6.9%], **Fig. 24**).
- 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=1.7% [95%CI: 0.4%, 3.0%]), with no significant change after 2009.
- There was a statistically significant increase in incidence of radiographically confirmed non-malignant tumors

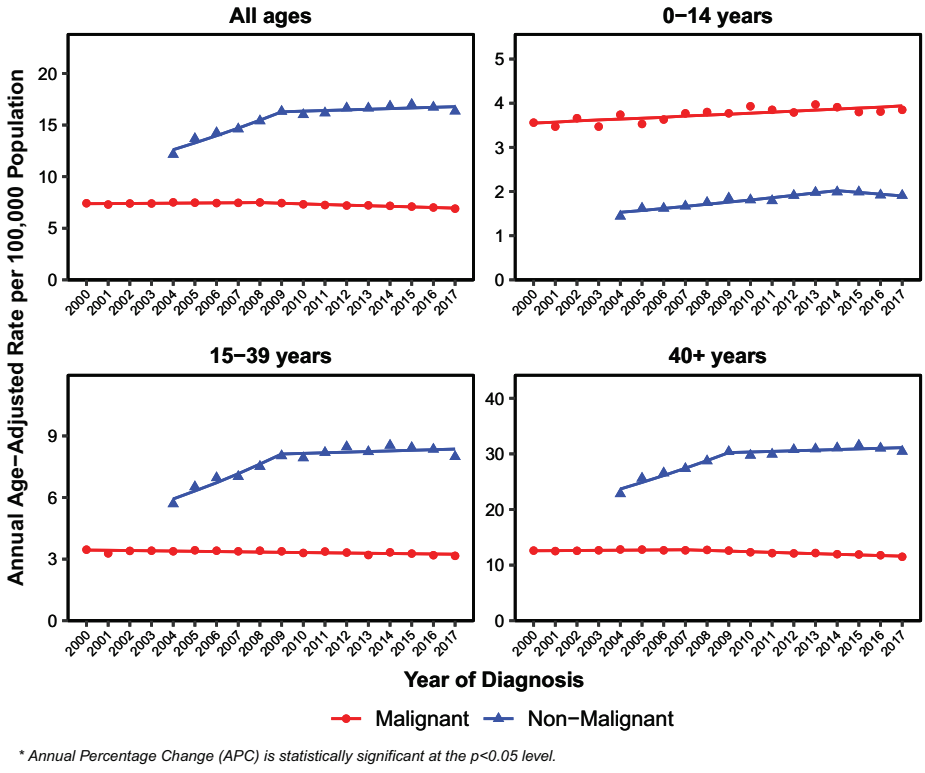


Fig. 24 Annual Age-Adjusted Incidence Rates of Primary Brain and Other CNS Tumors, and Incidence Trends by Behavior and Age Group, CBTRUS Statistical Report: US Cancer Statistics - NPCR and SEER, 2000-2017 (varying)

from 2004-2009 (APC=9.6% [95%CI: 6.9%, 12.4%]), 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 from 2004-2008 (APC=6.0% [95%CI: 3.8%, 8.3%]), **Fig. 26**), but there was no significant change after 2009.
- When analysis was limited to histologically confirmed cases, there was a slight non-significant increase in incidence from 2004-2008 (APC=1.6% [95%CI: -0.1%, 3.3%]) and there was a slight decrease (APC=-1.2% [95%CI: -1.6%, -0.7%]) from 2008-2017.
- There was a significant increase in incidence of radiographically diagnosed cases from 2004-2008 (APC=10.6% [95%CI: 7.4%, 13.9%]), and a smaller but still significant change from 2008-2017 (APC=2.0% [95%CI: 1.4%, 2.7%]).
- 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 from 2004-2014 (APC=1.8% [95%CI: 1.0%, 2.6%]), Supplementary Table 16).
- When analysis was limited to histologically confirmed cases only, there was a significant decrease in incidence (APC=-1.7% (95%CI: -3.3%, -0.2%]) from 2004-2010.
- There was a significant increase in incidence of radiographically diagnosed tumors from 2004-2007 (APC=8.7% [95%CI: 3.3%, 14.4%]) and 2007-2014 (APC=2.9% [95%CI: 1.4%, 4.4%]).
- 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.

Vestibular Schwannoma

Vestibular schwannoma (**Table 2**) is the most common type of nerve sheath tumor, representing 75% of all non-malignant nerve sheath tumors (**Fig. 8B**).

- There was a small but significant increase in the incidence of non-malignant nerve sheath tumors from 2004-2014 (APC=1.7% [95%CI: 1.0%, 2.5%]), **Fig. 26**), with a decrease from 2014-2017 (APC=-4.5% [95%CI:-8.8%, -0.0%]).

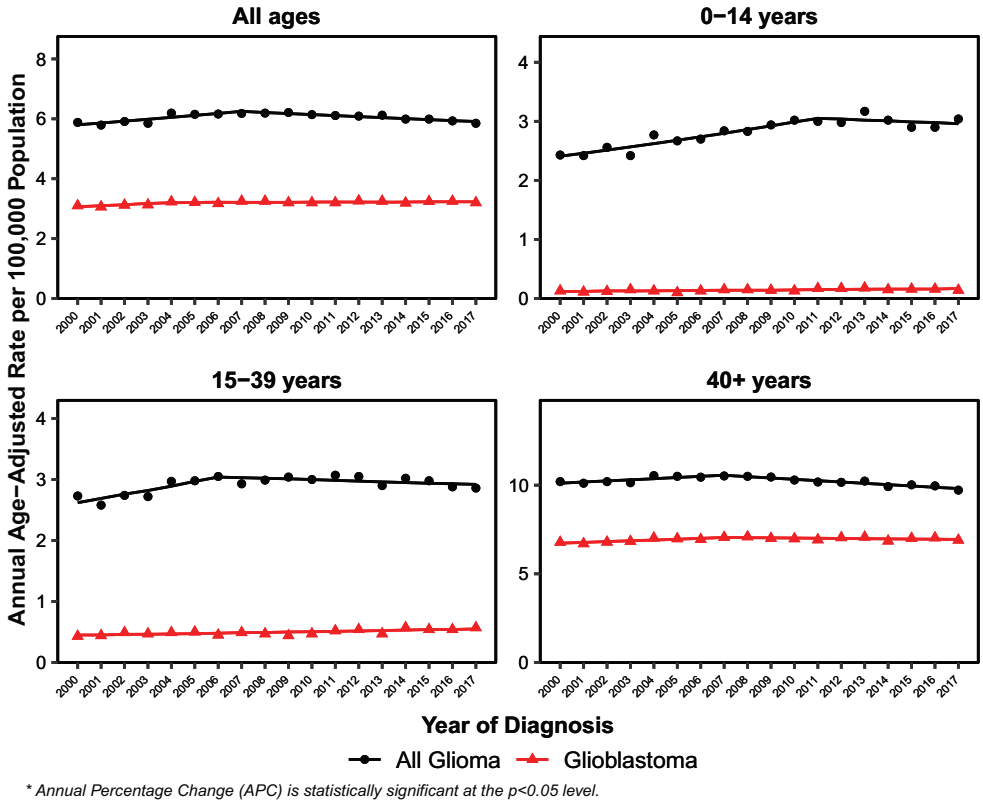


Fig. 25 Annual Age-Adjusted Incidence Rates of Primary Brain and Other CNS Gliomas and Glioblastoma, and Incidence Trends by Age Group, CBTRUS Statistical Report: US Cancer Statistics - NPCR and SEER, 2000-2017

- When analysis was limited to histologically confirmed cases only, there was a significant decrease in incidence (APC=-1.3% (95%CI: -1.9%, -0.8%]) from 2004-2017.
- There was a significant increase in incidence of radiographically diagnosed tumors from 2004-2007 (APC=9.5% [95%CI: 3.6%, 15.7%]) and 2007-2014 (APC=3.0% [95%CI: 1.4%, 45%]), with a significant decrease from 2014-2017 (APC=-4.2% [95%CI: -8.3%, 0.0%]).
- 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=7.8% [95%CI: 5.5%, 10.1%]), **Fig. 26**), and 2008-2012 (APC=3.3% [95%CI: 0.3%, 6.3%]), Fig. 27A) but no significant change in incidence from 2008-2016.
- When analysis was limited to histologically confirmed tumors only, there was a significant increase (APC=4.6% [95%CI: 3.2%, 6.0%]) from 2004-2009).
- There was a significant increase in incidence of radiographically diagnosed tumors of the pituitary from 2004-2008 (APC=11.5% [95%CI: 7.3%, 15.8%]) and 2008-2012 (APC=6.9% [95%CI: 1.9%, 12.1%]), with no significant change in incidence after 2012.

Prevalence of Primary Malignant Brain and Other CNS Tumors

Prevalence is an estimate of the total number of individuals with a disease who currently are alive 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 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 other CNS tumors to be 47.6 per 100,000 population, or a total of 103,634 cases.[65] 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[65] 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

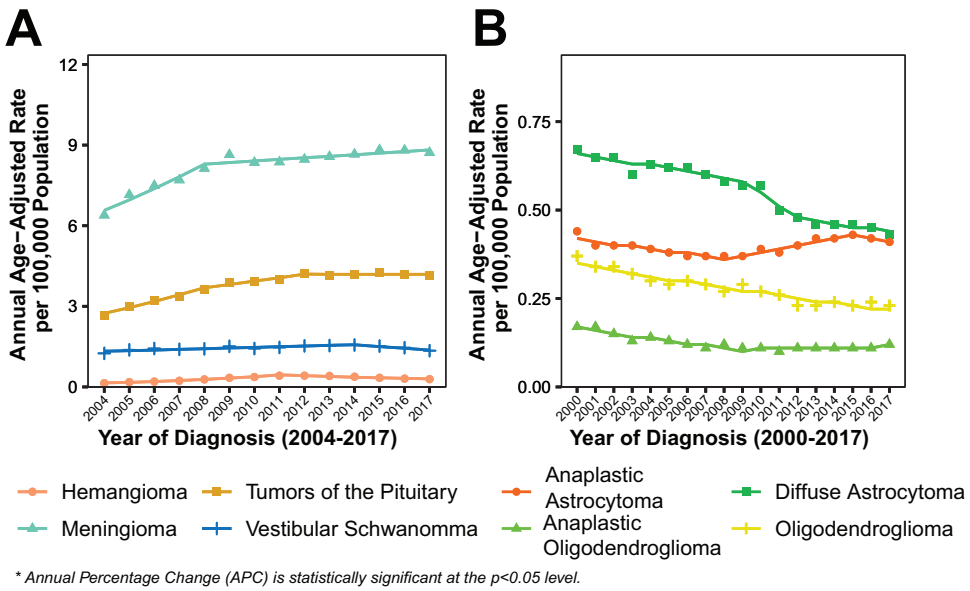


Fig. 26 Annual Age-Adjusted Incidence Rates of Primary Brain and Other CNS Tumors, and Incidence Trends by Histology for Selected A) Non-Malignant and B) Malignant Histologies, CBTRUS Statistical Report: US Cancer Statistics - NPCR and SEER, 2000-2017 (varying)

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[66] for more details, including sex-, race-, and ethnicity-specific prevalence estimates.

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 nasal cavity) and a 0.48% chance of dying from a primary **malignant** brain/other CNS tumor.[67-70]

- 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 risk factors for these tumors (particularly meningiomas) is an increased risk with exposure to ionizing radiation[71] (the type of radiation generated by atomic bombs, therapeutic radiation treatment, and some forms of medical imaging) and a decreased risk for these tumors (particularly glioma) in persons with a history of allergy or other atopic disease[72] (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.[73-78] Several recent review articles have elaborated on the current state of risk factor research in primary brain and other CNS tumors.[79-82]

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 24** 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[83] and Velázquez Vega and Brat[84], as well as in Guerreiro Stucklin, et al.[85] for discussion on pediatric biomarkers specifically.

Gliomas, as the most common malignant primary brain and other CNS tumor type, have been subject to the greatest investigation. A recent review has described in detail the current state of glioma biomarker research.[86] 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).[87] In general, these deletions significantly predict positive response to chemotherapy and radiation treatment in oligodendroglioma and anaplastic oligodendroglioma.[88-90] 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.[91-93] These mutations are common in lower grade gliomas (WHO grade II and WHO grade III), but are rare in glioblastoma.[92] 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.[94,95] The combination of these two factors can be used to more accurately stratify glioma by prognosis than the previously utilized histological criteria,[93,96] and have been incorporated into the definition of oligodendroglioma and astrocytoma in the 2016 update to the WHO classification.[21] **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 CCRs in the US starting January 1, 2018 and will be available to CBTRUS for the first time with the 2021 NPCR and SEER data releases.***

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*).[97,98] 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 (e.g. temozolomide) often used in the treatment of gliomas aimed to combat tumor growth through DNA damage.[99] This alteration is common in glioblastoma and less common in lower grade gliomas. Recent analyses of data generated by The Cancer Genome Atlas (TCGA) have shown that genome-wide DNA methylation predicts improved prognosis in addition to methylation of specific genes.[96] Persons whose tumor has a higher proportion of methylation across the genome are termed to have glioma-CpG island methylator phenotype (G-CIMP).[100] G-CIMP and *MGMT* methylation are correlated,[101] 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).[102] 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.[103-105]

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.[106-108] 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.[107,109,110] A recent review has further summarized recent developments in the genomics of DIPG.[111]

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).[112] 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. These data will be available to CBTRUS for the first time with the 2021 NPCR and SEER data releases for the 2018 diagnosis year only.

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 2013-2017* 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. CCRs, both NPCR and SEER, only report cases to the CDC and NCI for persons who 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 used for this report are collected by NPCR for 45 of the 51 CCR in the US—primarily through linkage with death certificate and other administrative records—and by SEER for the remaining CCR—through both active and passive methods—and the feasibility of these data for use in survival studies has been evaluated[113,114] 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,[115] 2000,[20] 2007,[2] and 2016.[21] 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 the histology at the time of case 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 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.[116,117] This also means that incomplete, incorrect, or alternatively stated diagnoses included in a pathology report or other medical record may 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*[21] 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 classification scheme. Recent molecular analyses suggest that these tumors are not molecularly distinct from oligodendrogliomas or astrocytomas[118] 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,[21] *IDH1/2* mutation and 1p/19q co-deletion will become the primary factors by which gliomas are classified. While data on *IDH1/2* mutation status was 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.[112] It is likely that these changes to diagnostic criteria may affect the incidence of these tumor types in future years of the *CBTRUS Statistical Report*.

Concluding Comment

The *CBTRUS Statistical Report: Primary Brain and Other Central Nervous System Tumors Diagnosed in the United States in 2013-2017* comprehensively describes the most up-to-date- (October 2020) population-based incidence, mortality, observed 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 US.[119]

Abbreviations

AAAIR – Average Annual Age-Adjusted Incidence Rate
AAAMR – Average Annual Age-Adjusted Mortality Rate
ABTA – American Brain Tumor Association
ACVR1 – Activin A receptor type I
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
G-CIMP – glioma-CpG island methylator phenotype
ICD-O-3 – International Classification of Diseases for Oncology, Third Edition
ICCC – International Classification of Childhood Cancer
IDH1/2 – Isocitrate Dehydrogenase ½
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
PDGFRA – Platelet-derived Growth Factor Receptor A
PI3KCA – Phosphatidylinositol 3-Kinase Catalytic sub-unit Alpha
PNET – Primitive Neuroectodermal Tumor
SEER – Surveillance Epidemiology and End Results
SHH – Sonic Hedgehog
SSF – Site Specific Factors
TCGA – The Cancer Genome Atlas
TP53 – Tumor Protein p53
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

Supplementary Material (Online Only)

Supplementary Table 1. Main and Extended Classification for ICCC Recode ICD-O-3/WHO 2008, based on WHO Classification of Tumors 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 2013-2017 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 2013-2017 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 2013-2017 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 Ratesb with 95% Confidence Intervals for Overall Cancer Incidence, and the Top Fifteen Most Incident Comparison Cancers by NCI Age Group, CBTRUS Statistical Report: NPCR and SEER, 2013-2017
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, 2013-2017
Supplementary Table 8. 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), CBTRUS Statistical Report: U.S. Cancer Statistics - NPCR and SEER, 2013-2017
Supplementary Table 9. Five-Year Total, Average Annual Total[a], and Average Annual Age-Adjusted Incidence Ratesb with 95% Confidence Intervals for Brain and Other Central Nervous System Tumors by Major Histology Grouping, Histology, Behavior and Urban/Rural Location of Residence, CBTRUS Statistical Report: U.S. Cancer Statistics - NPCR and SEER, 2013-2017
Supplementary Table 10. Estimated Number of Cases[a,b] of Brain and Other Central Nervous System Tumors Overall and by Age, Major Histology Grouping, and Histology, 2020, 2021
Supplementary Table 11. 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 Cancer Overall and by State and Urban/Rural Location of Residence[c], United States, 2013-2017
Supplementary Table 12. One-, Five-, and Ten-Year Relative Survival Rates[a,b] with 95% Confidence Intervals for Brain and Other Central Nervous System Tumors by Primary Site, CBTRUS Statistical Report: U.S. Cancer Statistics - NPCR, 2004-2016[c]
Supplementary Table 13. One-, Five-, and Ten-Year Relative Survival Rates[a,b] with 95% Confidence Intervals for Brain and Other Central Nervous System Tumors by Age Group, CBTRUS Statistical Report: U.S. Cancer Statistics - NPCR, 2004-2016[c]
Supplementary Table 14. One-, Five-, and Ten-Year Relative Survival Rates[a,b] with 95% Confidence Intervals for Brain and Other Central Nervous System Tumors by Histology, Behavior and Urban/Rural Location of Residence[c], CBTRUS Statistical Report: U.S. Cancer Statistics - NPCR, 2004-2016
Supplementary Table 15. 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, 2000-2017
Supplementary Table 16. 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: U.S. Cancer Statistics - NPCR and SEER, 2004-2017
Supplementary Fig. 1. Average Annual Age-Adjusted Incidence 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 for Children Age 0-14 Years, Adolescents and Young Adults Age 15-39 Years, and Older Adults Age 40+ Years in A) Males and B) Females, CBTRUS Statistical Report: U.S. Cancer Statistics – NPCR and SEER 2013-2017

Supplementary Figure 2. 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 for Children Age 0-14 Years, Adolescents and Young Adults Age 15-39 Years, and Older Adults Age 40+ Years in A) Males and B) Females, CBTRUS Statistical Report: NVSS, 2013-2017

Supplementary Figure 3. Distribution[a] of A) Malignant Primary Brain and Other CNS Tumors (Five-Year Total=123,484; Annual Average Cases=24,697) and B) Non-Malignant Primary Brain and Other CNS Tumors (Five-Year Total=291,927; Annual Average Cases=58,385) by Major Histology Groups, CBTRUS Statistical Report: U.S. Cancer Statistics – NPCR and SEER, 2013-2017

Supplementary Figure 4 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, 2013-2017

Supplementary Figure 5. Annual Age-Adjusted Incidence Rates[a] of Primary Brain and Other CNS Tumors by Year and Behavior, in A) Males and B) Females, CBTRUS Statistical Report: U.S. Cancer Statistics – NPCR and SEER, 2013-2017

Supplementary Figure 6. Distribution[a] of Schwannoma (9560/0) by Site (Five-Year Total=33,856; Annual Average Cases=6,771), CBTRUS Statistical Report: US Cancer Statistics - NPCR and SEER, 2013-2017

Supplementary Figure 7. Distribution[a] of Primary Brain and Other CNS Tumors, Males Only, Overall (Five-Year Total=173,641; Annual Average Cases=34,728), by A) Site and B) Histology, Malignant (Five-Year Total=68,578; Annual Average Cases=13,716), by C) Site and D) Histology, and Non- Malignant (Five-Year Total=105,063; Annual Average Cases=21,013), by E) Site and F) Histology, CBTRUS Statistical Report: US Cancer Statistics - NPCR and SEER, 2013-2017

Supplementary Figure 8. Distribution[a] of Primary Brain and Other CNS Tumors, Females Only, Overall (Five-Year Total=173,641; Annual Average Cases=48,354), by A) Site and B) Histology, Malignant (Five-Year Total=54,906; Annual Average Cases=10,981), by C) Site and D) Histology, and Non-Malignant (Five-Year Total=186,864; Annual Average Cases=37,373), by E) Site and F) Histology, CBTRUS Statistical Report: US Cancer Statistics - NPCR and SEER, 2013-2017

Supplementary Figure 9. Average Annual Age-Adjusted Incidence Rates[a] of Primary Brain and Other CNS Tumors by Age and Behavior, (A) Males, and (B) Females, CBTRUS Statistical Report: U.S. Cancer Statistics – NPCR and SEER, 2013-2017

Supplementary Figure 10. Average Annual Age-Adjusted Incidence Rates[a] with 95% Confidence Intervals of Selected Primary Brain and Other CNS Tumor Histologies by Sex, CBTRUS Statistical Report: US Cancer Statistics - NPCR and SEER, 2013-2017

Supplementary Figure 11. Average Annual Age-Adjusted Incidence Rates[a] of Malignant and Non-Malignant Primary Brain and Other CNS Tumors Combined by Central Cancer Registry, CBTRUS Statistical Report: U.S. Cancer Statistics – NPCR and SEER, 2013-2017

Supplementary Figure 12. Distribution[a] of Primary Brain and Other CNS Tumors Diagnosed in Puerto Rico by Behavior (Five-Year Total=2,356; Annual Average Cases=471), CBTRUS Statistical Report: U.S. Cancer Statistics – NPCR, 2013-2017

Supplementary Figure 13. Incidence Rate Ratios by Ethnicity (Non-Hispanic:Hispanic) for Selected Primary Brain and Other CNS Tumor Histologies, CBTRUS Statistical Report: US Cancer Statistics - NPCR and SEER, 2013-2017

Supplementary Figure 14. Incidence Rate Ratios for Meningioma with 95% Confidence Intervals by Behavior, Sex (Males:Females), and Age Group, CBTRUS Statistical Report: U.S. Cancer Statistics – NPCR and SEER, 2013-2017

Supplementary Figure 15. Relative Survival Rates for Meningioma by Behavior and Site, CBTRUS Statistical Report: U.S. Cancer Statistics – NPCR, 2004-2016

Supplementary Figure 16. 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, 2013-2017

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, malignant and non-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.

Acknowledgments

This report was prepared by the CBTRUS Scientific Principal Investigator, Jill Barnholtz-Sloan, Ph.D., her research staff affiliated with the Case Comprehensive Cancer Center, Case Western Reserve University School of Medicine, Quinn Ostrom, Ph.D., M.P.H. from Baylor College of Medicine, and CBTRUS President and Chief Mission Officer Carol Kruchko. The CBTRUS data presented in this report were provided through an agreement with the CDC, NPCR. In addition, CBTRUS used data from the research data files of the NCI, SEER Program. CBTRUS acknowledges and appreciates these contributions to this report and to cancer surveillance in general.

We acknowledge the efforts of the tumor registrars at hospitals and treatment centers, the CCRs, and the staff from the NPCR and SEER programs, whose efforts to collect accurate and complete data have made this report possible. We are also grateful to the four neuropathologists, Drs. Janet Bruner, Roger McLendon, Tarik Tihan, and Daniel Brat, who reviewed the CBTRUS histology grouping scheme, to our Consulting Neuropathologist, Dr. Janet Bruner, who answered our

questions and provided feedback throughout the year, to our Board of Directors and Advisors, and especially Hoda Anton-Culver, Ph.D., Elizabeth Claus, M.D.,Ph.D., Roberta McKean-Cowdin, Ph.D., Nancy Stroup, Ph.D., and Reda J, Wilson, M.P.H., C.T.R. who reviewed this report.

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 CDC or of the NCI.

The CBTRUS Scientific Team

Jill Barnholtz-Sloan, Ph.D., CBTRUS Scientific Principal Investigator, Professor, School of Medicine, Case Western Reserve University & Research and Education Institute, University Hospitals Health System, Cleveland, OH
Gino Cioffi, M.P.H., Research Associate, School of Medicine, Case Western Reserve University, Cleveland, OH
Quinn Ostrom, Ph.D., M.P.H., Postdoctoral Associate, Section of Epidemiology and Population Sciences, Department of Medicine, Baylor College of Medicine, Houston, TX
Nirav Patil, M.B.B.S., M.P.H, Senior Biostatistician, Research and Education Institute, University Hospitals Health System, Cleveland, OH
Kristin Waite, Ph.D., Assistant Director, Research Operation, Cleveland Center for Health Outcomes, Case Western Reserve University, Cleveland, OH

The CBTRUS Board of Directors

The CBTRUS Board of Advisors

Funding

CBTRUS is honored to be included among the research awardees of the following organizations which have contributed to the analyses resulting from the CBTRUS database in 2020: the Centers for Disease Control and Prevention (CDC) under Contract No.2016-M-9030, the American Brain Tumor Association, The Sontag Foundation, Novocure, the Musella Foundation, National Brain Tumor Society, the Uncle Kory Foundation, the Pediatric Brain Tumor Foundation, and the Zelda Dorin Tetenbaum Memorial Fund as well as private and in kind donations. QTO is supported by a Research Training Grant from the Cancer Prevention and Research Institute of Texas (CPRIT; RP160097T). Contents are solely the responsibility of the authors and do not necessarily represent the official views of the CDC or of the NCI.

Conflict of interest statement. The authors have no conflicts of interest to report.

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 July 21, 2020.
5. Wiśniewski JR, Zougman A, Nagaraj N, Mann M. Universal sample preparation method for proteome analysis. *Nature methods*. 2009; 6(5):359-362.
6. Benign Brain Tumor Cancer Registries Amendment Act, 107th Cong. § 260 (2002). http://www.gpo.gov/fdsys/pkg/PLAW-107publ260/pdf/PLAW-107publ260.pdf. Accessed July 21, 2020.
7. National Cancer Institute. Overview of the SEER Program. http://seer.cancer.gov/about/overview.html. Accessed July 21, 2020.
8. Walker EV, Davis FG, affiliates Cf. Malignant primary brain and other central nervous system tumors diagnosed in Canada from 2009 to 2013. *Neuro. Oncol*. 2019; 21(3):360-369.
9. Wohrer A, Waldhor T, Heinzl H, et al. The Austrian Brain Tumour Registry: a cooperative way to establish a population-based brain tumour registry. *Journal of neuro-oncology*. 2009; 95(3):401-411.
10. Asklund T, Malmstrom A, Bergqvist M, Bjor O, Henriksson R. Brain tumors in Sweden: data from a population-based registry 1999-2012. *Acta oncologica*. 2015; 54(3):377-384.
11. 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 – 2001-2017*. United States Department of Health and Human Services, Centers for Disease Control and Prevention and National Cancer Institute. Based on the November 2019 submission. 2020.
12. Fritz A PC, Jack A, Shanmugaratnam K, Sobin L, Perkin DM, Whelan S ed *International Classification of Diseases for Oncology, Third edition*: World Health Organization; 2000.
13. Surveillance Epidemiology and End Results (SEER) Program. SEER*Stat Database: Mortality - All COD, Aggregated With State, Total U.S. (1969-2017) <Katrina/Rita Population Adjustment>, National Cancer Institute, DCCPS, Surveillance Research Program, released December 2019. Underlying mortality data provided by NCHS (www.cdc.gov/nchs). 2019.
14. Standards for Cancer Registries Volume III: Standards for Completeness, Quality, Analysis, Management, Security and Confidentiality of Data. 2008; https://www.naaccr.org/wp-content/uploads/2016/11/Standards-for-Completeness-Quality-Analysis-Management-Security-and-Confidentiality-of-Data-August-2008PDF.pdf. Accessed July 21, 2020.
15. Bray F, Ferlay J. Data Comparability and Quality. *Cancer Incidence in Five Continents, Vol. XI (electronic version)* 2017; https://ci5.iarc.fr/CI5-XI/Pages/Chapter5.aspx. Accessed July 21, 2020.
16. 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. http://www.ncbi.nlm.nih.gov/pubmed/11916506.
17. Surveillance Research Program - National Cancer Institute. ICCC Recode ICD-O-3/WHO 2008. http://seer.cancer.gov/iccc/iccc-who2008.html.
18. Steliarova-Foucher E, Stiller C, Lacour B, Kaatsch P. International Classification of Childhood Cancer, third edition. *Cancer*. 2005; 103(7):1457-1467.
19. Swerdlow SH, Campo E, Harris NL, et al. *WHO Classification of Tumours of Haematopoietic and Lymphoid Tissues, Fourth Edition*: World Health Organization;2007.
20. Kleihues P, Cavenee W, eds. *Tumours of the nervous system: World Health Organization classification of tumours*. Lyon, France: IARC Press; 2000.
21. Louis DN OH, Wiestler OD, Cavanee WK, ed *WHO Classification of Tumours of the Central Nervous System*. Lyon, France: International Agency for Research on Cancer; 2016.
22. American Joint Committee on Cancer. Collaborative Stage Data Collection System Version 02.05. 2020; https://cancerstaging.org/cstage/schema/Pages/version0205.aspx. Accessed July 12, 2020.
23. 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.
24. 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.
25. Surveillance Research Program - National Cancer Institute. ICD-O-3 SEER Site/Histology Validation List. 2019; https://seer.cancer.gov/icd-o-3/sitetype.icdo3.20190618.pdf. Accessed July 14, 2020.
26. R Core Team. R: A language and environment for statistical computing. 2020; http://www.R-project.org/. Accessed July 21, 2020.
27. Surveillance Epidemiology and End Results (SEER) Program. SEER*Stat software version 8.3.6. 2020; www.seer.cancer.gov/seerstat. Accessed July 21, 2020.
28. Luo J. SEER2R: reading and writing SEER*STAT data files. R package version 1.0. 2012; http://CRAN.R-project.org/package=SEER2R. Accessed July 21, 2020.
29. Gohel D, Hangler F, Sander L, et al. officer: Manipulation of Microsoft Word and PowerPoint Documents. 2020; https://cloud.r-project.org/web/packages/officer/index.html. Accessed July 21, 2020.
30. Gohel D, Fazilleau Q, Nazarov M, Robert T, Barrowman M, Yasumoto A. flextable: Functions for Tabular Reporting. 2020; https://davidgohel.github.io/flextable/. Accessed July 21, 2020.
31. Hočevar T, Demšar J. Computation of Graphlet Orbits for Nodes and Edges in Sparse Graphs. *2016*. 2016; 71(10):24.
32. Wickham H, Averick M, Bryan J, et al. Welcome to the Tidyverse. *Journal of Open Source Software*. 2019; 4(43):1686.
33. Sievert C. Interactive Web-Based Data Visualization with R, plotly, and shiny. 2020; https://plotly-r.com. Accessed July 21, 2020.
34. Xie Y. knitr: A General-Purpose Package for Dynamic Report Generation in R. R package version 1.29. . 2020; https://yihui.org/knitr/. Accessed July 21, 2020.
35. Walker K, Rudis B. tigris: Load Census TIGER/Line Shapefiles. 2020; https://github.com/walkerke/tigris. Accessed July 21, 2020.
36. Kassambara A, Kosinski M, Biecek P, Fabian S. survminer: Drawing Survival Curves using 'ggplot2'. 2020; https://rpkgs.datanovia.com/survminer/index.html. Accessed July 21, 2020.
37. Pebesma E. Simple Features for R: Standardized Support for Spatial Vector Data. *The R Journal*. 2018; 10(1):439–446.
38. NAACCR Race and Ethnicity Work Group. NAACCR Guideline for Enhancing Hispanic/Latino Identification: Revised NAACCR Hispanic/Latino Identification Algorithm [NHIA v2.2.1]. . September 2012; https://

www.naaccr.org/wp-content/uploads/2016/11/NHIA-v2.2.1.pdf. Accessed July 21, 2020.

39. 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 July 21, 2020.
40. Surveillance Epidemiology and End Results (SEER) Program. SEER*Stat Database: Populations - Total U.S. (1990-2018) - Linked To County Attributes - Total U.S., 1969-2018 Counties, National Cancer Institute, DCCPS, Surveillance Research Program, released December 2019. 2019; http://seer.cancer.gov/popdata/.
41. Tiwari RC, Clegg LX, Zou Z. Efficient interval estimation for age-adjusted cancer rates. *Stat. Methods Med. Res.* 2006;15(6):547-569. http://www.ncbi.nlm.nih.gov/pubmed/17260923.
42. Fay MP, Tiwari RC, Feuer EJ, Zou Z. Estimating average annual percent change for disease rates without assuming constant change. *Biometrics.* 2006; 62(3):847-854.
43. Joinpoint Regression Program, Version 4.8.0.1; Statistical Methodology and Applications Branch, Surveillance Research Program, National Cancer Institute. 2020; https://surveillance.cancer.gov/joinpoint/. Accessed July 21, 2020.
44. 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.
45. 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.
46. Chu KC, Miller BA, Feuer EJ, Hankey BF. A method for partitioning cancer mortality trends by factors associated with diagnosis: an application to female breast cancer. *J. Clin. Epidemiol.* 1994; 47(12):1451-1461.
47. Surveillance Epidemiology and End Results (SEER) Program. *SEER*Stat Database: Incidence - SEER Research Data, 9 Registries, Nov 2019 Sub (1975-2017) - Linked To County Attributes - Time Dependent (1990-2017) Income/Rurality, 1969-2017 Counties*, National Cancer Institute, DCCPS, Surveillance Research Program, released April 2020, based on the November 2019 submission. 2020.
48. Louis DN, Perry A, Reifenberger G, et al. The 2016 World Health Organization Classification of Tumors of the Central Nervous System: a summary. *Acta Neuropathol.* 2016; 131(6):803-820.
49. Ferlay J, Rous B. Histological groups. In: Bray F, Colombet M, Ferlay J, et al., eds. *Cancer Incidence in Five Continents Volume XI2019.*
50. Surveillance Epidemiology and End Results (SEER) Program. Solid Tumor Rules: Non-Malignant CNS 2019; https://seer.cancer.gov/tools/solidtumor/Non_Malignant_CNS_STM.pdf. Accessed July 21, 2020.
51. Ostrom QT, Kruchko C, Barnholtz-Sloan JS. Pilocytic astrocytomas: where do they belong in cancer reporting? *Neuro. Oncol.* 2020; 22(2):298-300.
52. 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.
53. 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.
54. 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. http://www.ncbi.nlm.nih.gov/pubmed/12381706.
55. Midthune DN, Fay MP, Clegg LX, Feuer EJ. Modeling Reporting Delays and Reporting Corrections in Cancer Registry Data. *Journal of the American Statistical Association.* 2005; 100(469):61-70.
56. Surveillance Epidemiology and End Results (SEER) Program. Cancer Incidence Rates Adjusted for Reporting Delay. 2020; http://surveillance.cancer.gov/delay/. Accessed July 21, 2020.
57. Li XR, Kruchko C, Wu XC, et al. Are Benign and Borderline Brain Tumors Underreported? *J Registry Manag.* 2016; 43(4):187-194.
58. Anderson RN, Rosenberg HM. Report of the Second Workshop on Age Adjustment. *Vital Health Stat. 4.* 1998(30):I-vi, 1-37.
59. 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.
60. L. D, Johnson C, Adams S, Negoita S. Solid Tumor Rules. 2018; https://seer.cancer.gov/tools/solidtumor/. Accessed July 21, 2020.
61. 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.
62. Ostrom QT, Rubin JB, Lathia JD, Berens ME, Barnholtz-Sloan JS. Females have the survival advantage in glioblastoma. *Neuro. Oncol.* 2018; 20(4):576-577.
63. Ostrom QT, Cote DJ, Ascha M, Kruchko C, Barnholtz-Sloan JS. Adult Glioma Incidence and Survival by Race or Ethnicity in the United States From 2000 to 2014. *JAMA Oncol.* 2018; 4(9):1254-1262.
64. Siegel RL, Miller KD, Jemal A. Cancer statistics, 2019. *CA Cancer J Clin.* 2019; 69(1):7-34.
65. 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.
66. 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.
67. *DevCan: Probability of Developing or Dying of Cancer Software, Version 6.7.7 Surveillance Research Program, Statistical Methodology and Applications*, National Cancer Institute. 2012; https://surveillance.cancer.gov/devcan/. Accessed July 21, 2020.
68. Fay MP, Pfeiffer R, Cronin KA, Le C, Feuer EJ. Age-conditional probabilities of developing cancer. *Stat. Med.* 2003; 22(11):1837-1848.
69. Fay MP. Estimating age conditional probability of developing disease from surveillance data. *Population health metrics.* 2004; 2(1):6.
70. 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, released April 2019, based on the November 2018 submission. Underlying mortality data provided by NCHS.
71. 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.
72. 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.
73. 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.
74. 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.
75. 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.

76. 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.
77. 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.
78. Claus EB, Calvocoressi L, Bondy ML, Schildkraut JM, Wiemels JL, Wrensch M. Family and personal medical history and risk of meningioma. *J Neurosurg.* 2011; 115(6):1072-1077.
79. 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.
80. 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.
81. Wiemels J, Wrensch M, Claus EB. Epidemiology and etiology of meningioma. *J. Neurooncol.* 2010; 99(3):307-314.
82. Ostrom QT, Adel Fahmideh M, Cote DJ, et al. Risk Factors For Childhood And Adult Primary Brain Tumors. *Neuro. Oncol.* 2019.
83. Scheie D, Kufaishi HHA, Broholm H, et al. Biomarkers in tumors of the central nervous system - a review. *APMIS.* 2019; 127(5):265-287.
84. Velazquez Vega JE, Brat DJ. Incorporating Advances in Molecular Pathology Into Brain Tumor Diagnostics. *Adv. Anat. Pathol.* 2018; 25(3):143-171.
85. 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.
86. 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.
87. 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.
88. 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.
89. Vogelbaum MA, Hu C, Peereboom DM, et al. Phase II trial of pre-irradiation 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.
90. 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.
91. 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.
92. Yan H, Parsons DW, Jin G, et al. IDH1 and IDH2 mutations in gliomas. *N Engl J Med.* 2009; 360(8):765-773.
93. 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.
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. 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.
97. 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.
98. 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.
99. 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.
100. 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.
101. 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.
102. 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.
103. Northcott PA, Dubuc AM, Pfister S, Taylor MD. Molecular subgroups of medulloblastoma. *Expert Rev. Neurother.* 2012; 12(7):871-884.
104. Northcott PA, Jones DT, Kool M, et al. Medulloblastomics: the end of the beginning. *Nat. Rev. Cancer.* 2012 ;12(12):818-834.
105. Northcott PA, Buchhalter I, Morrissy AS, et al. The whole-genome landscape of medulloblastoma subtypes. *Nature.* 2017; 547(7663):311-317.
106. Jones C, Baker SJ. Unique genetic and epigenetic mechanisms driving paediatric diffuse high-grade glioma. *Nat. Rev. Cancer.* 2014; 14(10).
107. 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.
108. 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.
109. 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.
110. 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.
111. Lapin DH, Tsoli M, Ziegler DS. Genomic Insights into Diffuse Intrinsic Pontine Glioma. *Front. Oncol.* 2017; 7:57.
112. 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.
113. 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. *Journal of the National Cancer Institute Monogr.* 2014; 2014(49):198-209.
114. 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.
115. Kleihues P, Burger PC, Scheithauer BW. The new WHO classification of brain tumours. *Brain Pathol.* 1993; 3(3):255-268.

116. 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.
117. 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.
118. 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.
119. Kruchko C, Gittleman H, Ruhl J, et al. Cancer collection efforts in the United States provide clinically relevant data on all primary brain and other CNS tumors. *Neurooncol Pract.* 2019; 6(5):330-339.

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
Frontal lobe of brain	C71.1
Temporal lobe of brain	C71.2
Parietal lobe of brain	C71.3
Occipital lobe of brain	C71.4
Cerebrum	C71.0
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 equina	*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, Overall and by Behavior

Histology	ICD-O-3[a] Histology Code	ICD-O-3[a] Histology and Behavior Code[b]	
		Malignant	Non-Malignant
Tumors of Neuroepithelial Tissue			
Pilocytic astrocytoma*	9421, 9425[c]	9421/1, 9425/3[d]	*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[d]	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, 9432/1	*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[e], 9492 (excluding site C75.1), 9493, 9505, 9506, 9509, 9522, 9523	8680/3, 8693/3, 9505/3, 9509/3, 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, 9471, 9472, 9474	9470/3, 9471/3, 9472/3, 9474/3.	*None*
Primitive neuroectodermal tumors	*9473*	*9473/3.*	*None*
Atypical teratoid rhabdoid tumors	*9508*	*9508/3.*	*None*
Other embryonal histologies	*8963, 9364, 9480, 9490, 9500, 9501, 9502*	*8963/3, 9364/3, 9480/3, 9490/3, 9500/3, 9501/3, 9502/3*	*9490/0*
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	*9560 (C72.4 and C72.5 only)*	*None*	*9560/0 (C72.4 and C72.5 only)*
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

Table 2. *Continued*

Histology	ICD-O-3[a] Histology Code	ICD-O-3[a] Histology and Behavior Code[b]	
		Malignant	Non-Malignant
Primary melanocytic lesions	8720, 8728, 8770, 8771	8720/3, 8728/3, 8770/3, 8771/3	8728/0,1, 8770/0, 8771/0
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
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 included starting with diagnosis year 2015.
d. Morphology 9442/3 only.
e. Morphology 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, 9391-9460.*
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 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, 2013-2017

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	***113,056***	***22,611***	***27.2%***	***57***	***6.56***	***6.52-6.60***	***63,606***	***12,721***	***92.8%***	***7.2%***	***7.71***	***7.65-7.77***	***49,450***	***9,890***	***92.3%***	***7.7%***	***5.55***	***5.50-5.60***
Pilocytic Astrocytoma	5,167	1,033	1.2%	12	0.35	0.34-0.36	2,681	536	100.0%	0.0%	0.36	0.35-0.37	2,486	497	100.0%	0.0%	0.34	0.33-0.36
Diffuse Astrocytoma	7,428	1,486	1.8%	46	0.45	0.44-0.46	4,162	832	100.0%	0.0%	0.52	0.50-0.54	3,266	653	100.0%	0.0%	0.39	0.38-0.40
Anaplastic Astrocytoma	7,116	1,423	1.7%	53	0.42	0.41-0.43	3,892	778	100.0%	0.0%	0.48	0.46-0.49	3,224	645	100.0%	0.0%	0.37	0.36-0.38
Unique Astrocytoma Variants	1,123	225	0.3%	23	0.07	0.07-0.08	611	122	68.9%	31.1%	0.08	0.07-0.09	512	102	68.0%	32.0%	0.07	0.06-0.07
Malignant	*769*	*154*	--	*32*	*0.05*	*0.04-0.05*	*421*	*84*	--	--	*0.05*	*0.05-0.06*	*348*	*70*	--	--	*0.04*	*0.04-0.05*
Non-Malignant	*354*	*71*	--	*11*	*0.02*	*0.02-0.03*	*190*	*38*	--	--	*0.03*	*0.02-0.03*	*164*	*33*	--	--	*0.02*	*0.02-0.03*
Glioblastoma	60,056	12,011	14.5%	65	3.23	3.20-3.25	34,793	6,959	100.0%	0.0%	4.03	3.98-4.07	25,263	5,053	100.0%	0.0%	2.54	2.50-2.57
Oligodendroglioma	3,698	740	0.9%	44	0.23	0.23-0.24	2,031	406	100.0%	0.0%	0.26	0.25-0.27	1,667	333	100.0%	0.0%	0.21	0.20-0.22
Anaplastic Oligo-dendroglioma	1,859	372	0.4%	49	0.11	0.11-0.12	1,036	207	99.9%	0.1%	0.13	0.12-0.14	823	165	100.0%	0.0%	0.10	0.09-0.11
Oligoastrocytic Tumors	1,572	314	0.4%	42	0.10	0.09-0.10	893	179	100.0%	0.0%	0.11	0.11-0.12	679	136	99.9%	0.1%	0.08	0.08-0.09
Ependymal Tumors	6,843	1,369	1.6%	45	0.42	0.41-0.43	3,911	782	55.6%	44.4%	0.49	0.47-0.50	2,932	586	61.4%	38.6%	0.36	0.35-0.37
Malignant	*3,972*	*794*	--	*23*	*0.25*	*0.24-0.26*	*2,173*	*435*	--	--	*0.27*	*0.26-0.29*	*1,799*	*360*	--	--	*0.22*	*0.21-0.24*
Non-Malignant	*2,871*	*574*	--	*48*	*0.17*	*0.17-0.18*	*1,738*	*348*	--	--	*0.21*	*0.20-0.22*	*1,133*	*227*	--	--	*0.14*	*0.13-0.14*
Glioma Malignant, NOS	8,093	1,619	1.9%	36	0.51	0.50-0.52	4,089	818	100.0%	0.0%	0.53	0.51-0.55	4,004	801	100.0%	0.0%	0.49	0.47-0.50
Choroid Plexus Tumors	827	165	0.2%	20	0.05	0.05-0.06	425	85	16.7%	83.3%	0.06	0.05-0.06	402	80	14.2%	85.8%	0.05	0.05-0.06
Malignant	*128*	*26*	--	*2*	*0.01*	*0.01-0.01*	*71*	*14*	--	--	*0.01*	*0.01-0.01*	*57*	*11*	--	--	*0.01*	*0.01-0.01*
Non-Malignant	*699*	*140*	--	*24*	*0.05*	*0.04-0.05*	*354*	*71*	--	--	*0.05*	*0.04-0.05*	*345*	*69*	--	--	*0.04*	*0.04-0.05*
Other Neuroepithelial Tumors	107	21	0.0%	34	0.01	0.01-0.01	40	8	50.0%	50.0%	0.01	0.00-0.01	67	13	68.7%	31.3%	0.01	0.01-0.01
Malignant	*66*	*13*	--	*26.5*	*0.00*	*0.00-0.01*	*20*	*4*	--	--	*0.00*	*0.00-0.00*	*46*	*9*	--	--	*0.01*	*0.00-0.01*
Non-Malignant	*41*	*8*	--	*43*	*0.00*	*0.00-0.00*	*20*	*4*	--	--	*0.00*	*0.00-0.00*	*21*	*4*	--	--	*0.00*	*0.00-0.00*
Neuronal and Mixed Neuronal Glial Tumors	4,934	987	1.2%	26	0.32	0.31-0.33	2,672	534	20.5%	79.5%	0.34	0.33-0.36	2,262	452	17.6%	82.4%	0.29	0.28-0.31
Malignant	*947*	*189*	--	*52*	*0.06*	*0.05-0.06*	*549*	*110*	--	--	*0.07*	*0.06-0.07*	*398*	*80*	--	--	*0.05*	*0.04-0.05*
Non-Malignant	*3,987*	*797*	--	*22*	*0.26*	*0.25-0.27*	*2,123*	*425*	--	--	*0.28*	*0.27-0.29*	*1,864*	*373*	--	--	*0.25*	*0.24-0.26*

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
Tumors of the Pineal Region	787	157	0.2%	34	0.05	0.05-0.05	329	66	69.6%	30.4%	0.04	0.04-0.05	458	92	47.6%	52.4%	0.06	0.05-0.06
Malignant	*447*	*89*	--	*27*	*0.03*	*0.03-0.03*	*229*	*46*	--	--	*0.03*	*0.03-0.03*	*218*	*44*	--	--	*0.03*	*0.02-0.03*
Non-Malignant	*340*	*68*	--	*43*	*0.02*	*0.02-0.02*	*100*	*20*	--	--	*0.01*	*0.01-0.02*	*240*	*48*	--	--	*0.03*	*0.03-0.03*
Embryonal Tumors	3,446	689	0.8%	9	0.23	0.23-0.24	2,041	408	98.0%	2.0%	0.27	0.26-0.29	1,405	281	95.9%	4.1%	0.19	0.18-0.20
Tumors of Cranial and Spinal Nerves	***35,600***	***7,120***	***8.6%***	***57***	***2.03***	***2.01-2.05***	***17,038***	***3,408***	***0.7%***	***99.3%***	***2.02***	***1.99-2.06***	***18,562***	***3,712***	***0.6%***	***99.4%***	***2.05***	***2.02-2.08***
Nerve Sheath Tumors	35,560	7,112	8.6%	57	2.03	2.01-2.05	17,013	3,403	0.7%	99.3%	2.02	1.99-2.05	18,547	3,709	0.6%	99.4%	2.04	2.01-2.07
Malignant	*223*	*45*	--	*54*	*0.01*	*0.01-0.02*	*112*	*22*	--	--	*0.01*	*0.01-0.02*	*111*	*22*	--	--	*0.01*	*0.01-0.02*
Non-Malignant	*35,337*	*7,067*	--	*57*	*2.02*	*1.99-2.04*	*16,901*	*3,380*	--	--	*2.01*	*1.98-2.04*	*18,436*	*3,687*	--	--	*2.03*	*2.00-2.06*
Other Tumors of Cranial and Spinal Nerves	40	8	0.0%	54.5	0.00	0.00-0.00	--	--	--	--	--	--	--	--		--	--	--
Tumors of Meninges	***163,619***	***32,724***	***39.4%***	***66***	***9.09***	***9.04-9.13***	***45,497***	***9,099***	***2.6%***	***97.4%***	***5.56***	***5.51-5.61***	***118,122***	***23,624***	***1.1%***	***98.9%***	***12.22***	***12.15-12.29***
Meningioma	159,038	31,808	38.3%	66	8.81	8.77-8.86	43,082	8,616	1.8%	98.2%	5.26	5.21-5.31	115,956	23,191	0.8%	99.2%	11.96	11.89-12.03
Malignant	*1,750*	*350*	--	*65*	*0.10*	*0.09-0.10*	*768*	*154*	--	--	*0.09*	*0.08-0.10*	*982*	*196*	--	--	*0.10*	*0.09-0.11*
Non-Malignant	*157,288*	*31,458*	--	*66*	*8.72*	*8.67-8.76*	*42,314*	*8,463*	--	--	*5.17*	*5.12-5.22*	*114,974*	*22,995*	--	--	*11.86*	*11.79-11.93*
Mesenchymal Tumors	1,462	292	0.4%	49	0.09	0.08-0.09	722	144	34.9%	65.1%	0.09	0.08-0.10	740	148	30.8%	69.2%	0.09	0.08-0.09
Primary Melanocytic Lesions	108	22	0.0%	57.5	0.01	0.00-0.01	55	11	81.8%	18.2%	0.01	0.00-0.01	53	11	50.9%	49.1%	0.01	0.00-0.01
Other Neoplasms Related to the Meninges	3,011	602	0.7%	49	0.18	0.17-0.19	1,638	328	8.2%	91.8%	0.20	0.19-0.21	1,373	275	8.4%	91.6%	0.16	0.15-0.17
Lymphomas and Hematopoietic Neoplasms	***8,150***	***1,630***	***2.0%***	***67***	***0.45***	***0.44-0.46***	***4,129***	***826***	***--***	***--***	***0.49***	***0.48-0.51***	***4,021***	***804***	***--***	***--***	***0.41***	***0.40-0.42***
Lymphoma	7,919	1,584	1.9%	67	0.43	0.42-0.44	4,002	800	100.0%	0.0%	0.48	0.46-0.49	3,917	783	100.0%	0.0%	0.40	0.38-0.41
Other Hematopoietic Neoplasms	231	46	0.1%	47	0.01	0.01-0.02	127	25	96.1%	3.9%	0.02	0.01-0.02	104	21	92.3%	7.7%	0.01	0.01-0.02
Germ Cell Tumors and Cysts	***1,585***	***317***	***0.4%***	***16***	***0.11***	***0.10-0.11***	***1,094***	***219***	***76.7%***	***23.3%***	***0.14***	***0.14-0.15***	***491***	***98***	***52.1%***	***47.9%***	***0.07***	***0.06-0.07***
Germ Cell Tumors, Cysts and Heterotopias	1,585	317	0.4%	16	0.11	0.10-0.11	1,094	219	76.7%	23.3%	0.14	0.14-0.15	491	98	52.1%	47.9%	0.07	0.06-0.07
Malignant	*1,095*	*219*	--	*15*	*0.07*	*0.07-0.08*	*839*	*168*	--	--	*0.11*	*0.10-0.12*	*256*	*51*	--	--	*0.04*	*0.03-0.04*
Non-Malignant	*490*	*98*	--	*25.5*	*0.03*	*0.03-0.03*	*255*	*51*	--	--	*0.03*	*0.03-0.04*	*235*	*47*	--	--	*0.03*	*0.03-0.03*
Tumors of Sellar Region	***73,340***	***14,668***	***17.7%***	***51***	***4.39***	***4.36-4.43***	***33,190***	***6,638***	***0.3%***	***99.7%***	***4.02***	***3.98-4.07***	***40,150***	***8,030***	***0.1%***	***99.9%***	***4.85***	***4.80-4.90***

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
Tumors of the Pituitary	70,211	14,042	16.9%	51	4.20	4.17-4.23	31,611	6,322	0.3%	99.7%	3.82	3.78-3.87	38,600	7,720	0.1%	99.9%	4.66	4.61-4.71
Malignant	*142*	*28*	--	*57*	*0.01*	*0.01-0.01*	*86*	*17*	--	--	*0.01*	*0.01-0.01*	*56*	*11*	--	--	*0.01*	*0.00-0.01*
Non-Malignant	*70,069*	*14,014*	--	*51*	*4.19*	*4.16-4.22*	*31,525*	*6,305*	--	--	*3.81*	*3.77-3.86*	*38,544*	*7,709*	--	--	*4.65*	*4.61-4.70*
Craniophary ngioma	3,129	626	0.8%	44	0.19	0.19-0.20	1,579	316	0.6%	99.4%	0.20	0.19-0.21	1,550	310	0.3%	99.7%	0.19	0.18-0.20
Unclassified Tumors	***20,061***	***4,012***	***4.8%***	***64***	***1.16***	***1.14-1.17***	***9,087***	***1,817***	***34.9%***	***65.1%***	***1.15***	***1.12-1.17***	***10,974***	***2,195***	***31.8%***	***68.2%***	***1.18***	***1.15-1.20***
Hemangioma	5,731	1,146	1.4%	50	0.34	0.34-0.35	2,518	504	0.4%	99.6%	0.31	0.30-0.33	3,213	643	0.4%	99.6%	0.38	0.36-0.39
Neoplasm Unspecified	14,136	2,827	3.4%	70	0.80	0.79-0.82	6,451	1,290	48.6%	51.4%	0.82	0.80-0.84	7,685	1,537	44.9%	55.1%	0.79	0.77-0.81
Malignant	*6,587*	*1,317*	--	*76*	*0.36*	*0.35-0.37*	*3,135*	*627*	--	--	*0.40*	*0.39-0.41*	*3,452*	*690*	--	--	*0.33*	*0.32-0.35*
Non-Malignant	*7,549*	*1,510*	--	*63*	*0.44*	*0.43-0.45*	*3,316*	*663*	--	--	*0.42*	*0.41-0.44*	*4,233*	*847*	--	--	*0.46*	*0.44-0.47*
All Other	194	39	0.0%	66	0.01	0.01-0.01	118	24	20.3%	79.7%	0.02	0.01-0.02	76	15	31.6%	68.4%	0.01	0.01-0.01
TOTAL[c]	**415,411**	**83,082**	**--**	**60**	**23.79**	**23.71-23.86**	**173,641**	**34,728**	**39.5%**	**60.5%**	**21.09**	**20.99-21.20**	**241,770**	**48,354**	**22.7%**	**77.3%**	**26.31**	**26.21-26.42**
Malignant	***123,484***	***24,697***	***29.7%***	***60***	***7.08***	***7.04-7.12***	***68,578***	***13,716***	**--**	**--**	***8.30***	***8.24-8.36***	***54,906***	***10,981***	**--**	**--**	***6.01***	***5.95-6.06***
Non-Malignant	***291,927***	***58,385***	***70.3%***	***61***	***16.71***	***16.64-16.77***	***105,063***	***21,013***	**--**	**--**	***12.80***	***12.72-12.88***	***186,864***	***37,373***	**--**	**--**	***20.31***	***20.21-20.40***

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 20 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 4. Five-Year Total, Annual Average Total[a], and Average Annual Age-Adjusted Incidence Rates[b] with 95% Confidence Intervals for Selected Non-Malignant Histologies by Sex, Age Groups, Race, and Hispanic Ethnicity, Histology, and Age at Diagnosis, CBTRUS Statistical Report: U.S. Cancer Statistics – NPCR and SEER, 2013-2017

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
Sex																
Male	12,349	2,470	1.45	1.42-1.48	27,424	5,485	3.31	3.27-3.35	39,166	7,833	4.79	4.74-4.84	3,148	630	0.38	0.36-0.39
Female	14,039	2,808	1.53	1.50-1.55	33,206	6,641	3.99	3.95-4.04	110,469	22,094	11.37	11.31-11.44	4,505	901	0.49	0.47-0.50
Age Groups																
0-14 Years	197	39	0.07	0.06-0.08	861	172	0.29	0.27-0.31	202	40	0.07	0.06-0.08	82	16	0.03	0.02-0.03
15-39 Years	3,584	717	0.70	0.67-0.72	17,234	3,447	3.27	3.22-3.32	8,449	1,690	1.69	1.66-1.73	867	173	0.17	0.16-0.18
40-64 Years	14,168	2,834	2.56	2.52-2.61	26,299	5,260	5.00	4.94-5.06	58,789	11,758	10.45	10.36-10.54	3,504	701	0.63	0.61-0.66
65+ Years	8,439	1,688	3.53	3.45-3.60	16,236	3,247	6.92	6.81-7.02	82,195	16,439	35.57	35.32-35.81	3,200	640	1.37	1.33-1.42
Race																
White	22,745	4,549	1.58	1.56-1.60	43,492	8,698	3.25	3.22-3.29	121,777	24,355	8.11	8.06-8.15	5,969	1,194	0.41	0.40-0.42
Black	1,449	290	0.68	0.65-0.72	12,120	2,424	5.82	5.72-5.93	18,689	3,738	9.54	9.40-9.68	1,131	226	0.55	0.52-0.59
American Indian/Alaska Native	154	31	0.75	0.63-0.89	502	100	2.49	2.26-2.73	890	178	5.29	4.93-5.67	37	7	0.23	0.15-0.32
Asian or Pacific Islander	1,174	235	1.18	1.11-1.25	2,454	491	2.49	2.39-2.60	5,270	1,054	5.87	5.71-6.03	357	71	0.37	0.33-0.41
Hispanic Ethnicity																
Non-Hispanic	24,181	4,836	1.57	1.55-1.59	50,948	10,190	3.55	3.51-3.58	135,219	27,044	8.39	8.34-8.43	6,976	1,395	0.45	0.44-0.46
Hispanic	2,207	441	1.00	0.96-1.05	9,682	1,936	4.08	3.99-4.17	14,416	2,883	7.79	7.66-7.92	677	135	0.33	0.30-0.35
TOTAL	**21,453**	**4,291**	**1.20**	**1.19-1.22**	**60,630**	**12,126**	**3.61**	**3.58-3.64**	**149,635**	**29,927**	**8.29**	**8.24-8.33**	**7,653**	**1,531**	**0.43**	**0.42-0.44**

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 and ICD-O-3 topography code C72.4 and C72.5.
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

Table 5. 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 Major Histology Grouping, Histology, and NCI Age Group, CBTRUS Statistical Report: U.S. Cancer Statistics – NPCR and SEER, 2013-2017

Histology	Age at Diagnosis											
	Children[c] (0-14) Years				AYA[d] (15-39) Years				Adults (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	**12,719**	**2,544**	**4.19**	**4.12-4.26**	**18,350**	**3,670**	**3.46**	**3.41-3.52**	**81,987**	**16,397**	**10.30**	**10.23-10.37**
Pilocytic Astrocytoma	3,128	626	1.03	0.99-1.07	1,460	292	0.27	0.26-0.29	579	116	0.08	0.07-0.09
Diffuse Astrocytoma	703	141	0.23	0.21-0.25	2,392	478	0.45	0.43-0.47	4,333	867	0.57	0.55-0.58
Anaplastic Astrocytoma	283	57	0.09	0.08-0.11	1,858	372	0.35	0.34-0.37	4,975	995	0.64	0.62-0.66
Unique Astrocytoma Variants	379	76	0.13	0.11-0.14	387	77	0.07	0.06-0.08	357	71	0.05	0.04-0.05
Malignant	*158*	*32*	*0.05*	*0.04-0.06*	*289*	*58*	*0.05*	*0.05-0.06*	*322*	*64*	*0.04*	*0.04-0.05*
Non-Malignant	*221*	*44*	*0.07*	*0.06-0.08*	*98*	*20*	*0.02*	*0.01-0.02*	*35*	*7*	*0.00*	*0.00-0.01*
Glioblastoma	480	96	0.16	0.14-0.17	2,767	553	0.54	0.52-0.56	56,809	11,362	6.97	6.91-7.03
Oligodendroglioma	86	17	0.03	0.02-0.04	1,431	286	0.27	0.26-0.29	2,181	436	0.30	0.29-0.32
Anaplastic Oligodendroglioma	--	--	--	--	--	--	--	--	1,346	269	0.18	0.17-0.19
Oligoastrocytic Tumors	38	8	0.01	0.01-0.02	643	129	0.12	0.11-0.13	891	178	0.12	0.11-0.13
Ependymal Tumors	959	192	0.32	0.30-0.34	1,893	379	0.36	0.34-0.38	3,991	798	0.53	0.51-0.55
Malignant	*845*	*169*	*0.28*	*0.26-0.30*	*1,033*	*207*	*0.20*	*0.18-0.21*	*2,094*	*419*	*0.28*	*0.26-0.29*
Non-Malignant	*114*	*23*	*0.04*	*0.03-0.05*	*860*	*172*	*0.16*	*0.15-0.17*	*1,897*	*379*	*0.25*	*0.24-0.26*
Glioma Malignant, NOS	2,558	512	0.84	0.81-0.88	1,662	332	0.31	0.30-0.33	3,873	775	0.50	0.49-0.52
Choroid Plexus Tumors	365	73	0.12	0.11-0.13	216	43	0.04	0.04-0.05	246	49	0.03	0.03-0.04
Malignant	*101*	*20*	*0.03*	*0.03-0.04*	--	--	--	--	--	--	--	--
Non-Malignant	*264*	*53*	*0.09*	*0.08-0.10*	--	--	--	--	--	--	--	--
Other Neuroepithelial Tumors	25	5	0.01	0.01-0.01	36	7	0.01	0.00-0.01	46	9	0.01	0.00-0.01
Malignant	--	--	--	--	--	--	--	--	*22*	*4*	*0.00*	*0.00-0.00*
Non-Malignant	--	--	--	--	--	--	--	--	*24*	*5*	*0.00*	*0.00-0.00*
Neuronal and Mixed Neuronal Glial Tumors	1,298	260	0.43	0.41-0.45	1,981	396	0.37	0.35-0.38	1,655	331	0.22	0.21-0.23
Malignant	*70*	*14*	*0.02*	*0.02-0.03*	*199*	*40*	*0.04*	*0.03-0.04*	*678*	*136*	*0.09*	*0.08-0.09*
Non-Malignant	*1,228*	*246*	*0.41*	*0.38-0.43*	*1,782*	*356*	*0.33*	*0.32-0.35*	*977*	*195*	*0.14*	*0.13-0.14*
Tumors of the Pineal Region	153	31	0.05	0.04-0.06	289	58	0.05	0.05-0.06	345	69	0.05	0.04-0.05
Malignant	*133*	*27*	*0.04*	*0.04-0.05*	*162*	*32*	*0.03*	*0.03-0.03*	*152*	*30*	*0.02*	*0.02-0.02*
Non-Malignant	*20*	*4*	*0.01*	*0.00-0.01*	*127*	*25*	*0.02*	*0.02-0.03*	*193*	*39*	*0.03*	*0.02-0.03*
Embryonal Tumors	2,252	450	0.74	0.71-0.77	834	167	0.15	0.14-0.16	360	72	0.05	0.04-0.06
Medulloblastoma	*1,463*	*293*	*0.48*	*0.46-0.51*	*632*	*126*	*0.12*	*0.11-0.13*	*155*	*31*	*0.02*	*0.02-0.03*

Table 5. Continued

Histology	Age at Diagnosis											
	Children[c] (0-14) Years				AYA[d] (15-39) Years				Adults (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
Primitive neuroectodermal tumors	*214*	*43*	*0.07*	*0.06-0.08*	*102*	*20*	*0.02*	*0.02-0.02*	*111*	*22*	*0.01*	*0.01-0.02*
Atypical teratoid rhabdoid tumor	*374*	*75*	*0.12*	*0.11-0.14*	*28*	*6*	*0.01*	*0.00-0.01*	--	--	--	--
Other embryonal histologies	*201*	*40*	*0.07*	*0.06-0.08*	*72*	*14*	*0.01*	*0.01-0.02*	*81*	*16*	*0.01*	*0.01-0.01*
Tumors of Cranial and Spinal Nerves	**840**	**168**	**0.28**	**0.26-0.30**	**5,430**	**1,086**	**1.05**	**1.02-1.08**	**29,330**	**5,866**	**3.72**	**3.67-3.76**
Nerve Sheath Tumors	840	168	0.28	0.26-0.30	5,422	1,084	1.05	1.02-1.08	29,298	5,860	3.71	3.67-3.76
Malignant	--	--	--	--	--	--	--	--	--	--	--	--
Non-Malignant	--	--	--	--	--	--	--	--	--	--	--	--
Other Tumors of Cranial and Spinal Nerves	--	--	--	--	--	--	--	--	32	6	0.00	0.00-0.01
Tumors of Meninges	**592**	**118**	**0.20**	**0.18-0.21**	**10,765**	**2,153**	**2.14**	**2.09-2.18**	**152,262**	**30,452**	**19.26**	**19.16-19.36**
Meningioma	306	61	0.10	0.09-0.11	9,438	1,888	1.89	1.85-1.92	149,294	29,859	18.88	18.78-18.97
Malignant	*22*	*4*	*0.01*	*0.00-0.01*	*122*	*24*	*0.02*	*0.02-0.03*	*1,606*	*321*	*0.20*	*0.19-0.21*
Non-Malignant	*284*	*57*	*0.09*	*0.08-0.11*	*9,316*	*1,863*	*1.86*	*1.82-1.90*	*147,688*	*29,538*	*18.68*	*18.58-18.77*
Mesenchymal Tumors	223	45	0.07	0.06-0.08	334	67	0.06	0.06-0.07	905	181	0.12	0.11-0.13
Primary Melanocytic Lesions	--	--	--	--	--	--	--	--	85	17	0.01	0.01-0.01
Other Neoplasms Related to the Meninges	55	11	0.02	0.01-0.02	978	196	0.18	0.17-0.20	1,978	396	0.26	0.25-0.27
Lymphoma and Hematopoietic Neoplasms	***78***	***16***	***0.03***	***0.02-0.03***	***548***	***110***	***0.11***	***0.10-0.11***	***7,524***	***1,505***	***0.94***	***0.92-0.96***
Lymphoma	29	6	0.01	0.01-0.01	491	98	0.09	0.09-0.10	7,399	1,480	0.93	0.90-0.95
Other Hematopoietic Neoplasms	49	10	0.02	0.01-0.02	57	11	0.01	0.01-0.01	125	25	0.02	0.01-0.02
Germ Cell Tumors and Cysts	**694**	**139**	**0.23**	**0.21-0.25**	**700**	**140**	**0.13**	**0.12-0.14**	**191**	**38**	**0.03**	**0.02-0.03**
Germ Cell Tumors, Cysts and Heterotopias	694	139	0.23	0.21-0.25	700	140	0.13	0.12-0.14	191	38	0.03	0.02-0.03
Malignant	*508*	*102*	*0.17*	*0.15-0.18*	*558*	*112*	*0.10*	*0.09-0.11*	*29*	*6*	*0.00*	*0.00-0.01*
Non-Malignant	*186*	*37*	*0.06*	*0.05-0.07*	*142*	*28*	*0.03*	*0.02-0.03*	*162*	*32*	*0.02*	*0.02-0.03*
Tumors of Sellar Region	***1,715***	***343***	***0.57***	***0.54-0.60***	***21,491***	***4,298***	***4.07***	***4.02-4.13***	***50,134***	***10,027***	***6.57***	***6.51-6.63***
Tumors of the Pituitary	1,029	206	0.34	0.32-0.36	20,782	4,156	3.94	3.88-3.99	48,400	9,680	6.34	6.28-6.40
Malignant	--	--	--	--	--	--	--	--	--	--	--	--
Non-Malignant	--	--	--	--	--	--	--	--	--	--	--	--

Table 5. Continued

Histology	Age at Diagnosis											
	Children[c] (0-14) Years				AYA[d] (15-39) Years				Adults (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
Craniopharyngioma	686	137	0.23	0.21-0.24	709	142	0.13	0.12-0.14	1,734	347	0.22	0.21-0.24
Unclassified Tumors	**1,035**	**207**	**0.34**	**0.32-0.36**	**3,074**	**615**	**0.58**	**0.56-0.60**	**15,952**	**3,190**	**2.04**	**2.01-2.07**
Hemangioma	374	75	0.12	0.11-0.14	1,506	301	0.29	0.27-0.30	3,851	770	0.50	0.49-0.52
Neoplasm Unspecified	628	126	0.21	0.19-0.22	1,548	310	0.29	0.28-0.31	11,960	2,392	1.52	1.49-1.55
Malignant	*164*	*33*	*0.05*	*0.05-0.06*	*348*	*70*	*0.07*	*0.06-0.07*	*6,075*	*1,215*	*0.76*	*0.74-0.78*
Non-Malignant	*464*	*93*	*0.15*	*0.14-0.17*	*1,200*	*240*	*0.23*	*0.21-0.24*	*5,885*	*1,177*	*0.76*	*0.74-0.78*
All Other	33	7	0.01	0.01-0.02	20	4	0.00	0.00-0.01	141	28	0.02	0.01-0.02
TOTAL[e]	**17,673**	**3,535**	**5.83**	**5.74-5.91**	**60,358**	**12,072**	**11.54**	**11.45-11.63**	**337,380**	**67,476**	**42.85**	**42.71-43.00**
Malignant	***11,738***	***2,348***	***3.87***	***3.80-3.94***	***17,073***	***3,415***	***3.23***	***3.18-3.28***	***94,673***	***18,935***	***11.86***	***11.78-11.94***
Non-Malignant	***5,935***	***1,187***	***1.96***	***1.91-2.01***	***43,285***	***8,657***	***8.31***	***8.23-8.39***	***242,707***	***48,541***	***30.99***	***30.87-31.12***

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: http://www.cancer.gov/researchandfunding/snapshots/pediatric.
d. Adolescents and Young Adults (AYA), as defined by the National Cancer Institute, see: http://www.cancer.gov/cancertopics/aya.
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. 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, 2013-2017

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	**15,802**	**3,160**	**3.88**	**3.82-3.94**	**4,875**	**975**	**4.93**	**4.79-5.07**	**4,097**	**819**	**4.03**	**3.91-4.16**	**3,747**	**749**	**3.65**	**3.53-3.77**	**3,083**	**617**	**2.94**	**2.84-3.05**
Pilocytic Astrocytoma	3,744	749	0.92	0.89-0.95	1,148	230	1.16	1.09-1.23	1,059	212	1.04	0.98-1.11	921	184	0.90	0.84-0.96	616	123	0.59	0.54-0.64
Diffuse Astrocytoma	954	191	0.23	0.22-0.25	263	53	0.27	0.23-0.30	190	38	0.19	0.16-0.22	250	50	0.24	0.21-0.28	251	50	0.24	0.21-0.27
Anaplastic Astrocytoma	394	79	0.10	0.09-0.11	66	13	0.07	0.05-0.08	107	21	0.11	0.09-0.13	110	22	0.11	0.09-0.13	111	22	0.11	0.09-0.13
Unique Astrocytoma Variants	490	98	0.12	0.11-0.13	103	21	0.10	0.09-0.13	127	25	0.12	0.10-0.15	149	30	0.15	0.12-0.17	111	22	0.11	0.09-0.13
Malignant	*237*	*47*	*0.06*	*0.05-0.07*	*19*	*4*	*0.02*	*0.01-0.03*	*52*	*10*	*0.05*	*0.04-0.07*	*87*	*17*	*0.08*	*0.07-0.10*	*79*	*16*	*0.08*	*0.06-0.09*
Non-Malignant	*253*	*51*	*0.06*	*0.05-0.07*	*84*	*17*	*0.09*	*0.07-0.11*	*75*	*15*	*0.07*	*0.06-0.09*	*62*	*12*	*0.06*	*0.05-0.08*	*32*	*6*	*0.03*	*0.02-0.04*
Glioblastoma	717	143	0.18	0.16-0.19	110	22	0.11	0.09-0.13	169	34	0.17	0.14-0.19	201	40	0.20	0.17-0.22	237	47	0.23	0.20-0.26
Oligodendroglioma	175	35	0.04	0.04-0.05	19	4	0.02	0.01-0.03	25	5	0.02	0.02-0.04	42	8	0.04	0.03-0.06	89	18	0.08	0.07-0.10
Anaplastic Oligodendroglioma	27	5	0.01	0.00-0.01	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Oligoastrocytic Tumors	64	13	0.02	0.01-0.02	--	--	--	--	--	--	--	--	--	--	--	--	26	5	0.02	0.02-0.04
Ependymal Tumors	1,191	238	0.29	0.28-0.31	457	91	0.46	0.42-0.51	242	48	0.24	0.21-0.27	260	52	0.25	0.22-0.29	232	46	0.22	0.19-0.25
Malignant	*997*	*199*	*0.24*	*0.23-0.26*	*439*	*88*	*0.44*	*0.40-0.49*	*215*	*43*	*0.21*	*0.18-0.24*	*191*	*38*	*0.19*	*0.16-0.21*	*152*	*30*	*0.14*	*0.12-0.17*
Non-Malignant	*194*	*39*	*0.05*	*0.04-0.05*	*18*	*4*	*0.02*	*0.01-0.03*	*27*	*5*	*0.03*	*0.02-0.04*	*69*	*14*	*0.07*	*0.05-0.09*	*80*	*16*	*0.08*	*0.06-0.09*
Glioma Malignant, NOS	2,989	598	0.73	0.71-0.76	930	186	0.94	0.88-1.00	967	193	0.95	0.89-1.01	661	132	0.64	0.60-0.69	431	86	0.41	0.37-0.45
Choroid Plexus Tumors	409	82	0.10	0.09-0.11	258	52	0.26	0.23-0.30	54	11	0.05	0.04-0.07	53	11	0.05	0.04-0.07	44	9	0.04	0.03-0.06
Malignant	*104*	*21*	*0.03*	*0.02-0.03*	*85*	*17*	*0.09*	*0.07-0.11*	--	--	--	--	--	--	--	--	--	--	--	--
Non-Malignant	*305*	*61*	*0.07*	*0.07-0.08*	*173*	*35*	*0.18*	*0.15-0.20*	--	--	--	--	--	--	--	--	--	--	--	--
Other Neuroepithelial Tumors	32	6	0.01	0.01-0.01	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Malignant	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Non-Malignant	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Neuronal and Mixed Neuronal Glial Tumors	1,927	385	0.47	0.45-0.49	331	66	0.34	0.30-0.37	357	71	0.35	0.32-0.39	610	122	0.59	0.55-0.64	629	126	0.60	0.55-0.65
Malignant	*111*	*22*	*0.03*	*0.02-0.03*	*23*	*5*	*0.02*	*0.01-0.03*	*20*	*4*	*0.02*	*0.01-0.03*	*27*	*5*	*0.03*	*0.02-0.04*	*41*	*8*	*0.04*	*0.03-0.05*
Non-Malignant	*1,816*	*363*	*0.44*	*0.42-0.47*	*308*	*62*	*0.31*	*0.28-0.35*	*337*	*67*	*0.33*	*0.30-0.37*	*583*	*117*	*0.57*	*0.52-0.62*	*588*	*118*	*0.56*	*0.52-0.61*
Tumors of the Pineal Region	211	42	0.05	0.04-0.06	60	12	0.06	0.05-0.08	48	10	0.05	0.03-0.06	45	9	0.04	0.03-0.06	58	12	0.06	0.04-0.07
Malignant	*174*	*35*	*0.04*	*0.04-0.05*	--	--	--	--	--	--	--	--	--	--	--	--	*41*	*8*	*0.04*	*0.03-0.05*
Non-Malignant	*37*	*7*	*0.01*	*0.01-0.01*	--	--	--	--	--	--	--	--	--	--	--	--	*17*	*3*	*0.02*	*0.01-0.03*

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
Embryonal Tumors	2,478	496	0.61	0.58-0.63	1,106	221	1.12	1.05-1.19	727	145	0.72	0.66-0.77	419	84	0.41	0.37-0.45	226	45	0.22	0.19-0.25
Medulloblastoma	*1,637*	*327*	*0.40*	*0.38-0.42*	*492*	*98*	*0.50*	*0.45-0.54*	*619*	*124*	*0.61*	*0.56-0.66*	*352*	*70*	*0.34*	*0.31-0.38*	*174*	*35*	*0.17*	*0.14-0.19*
Primitive neuroectodermal tumors	*241*	*48*	*0.06*	*0.05-0.07*	*129*	*26*	*0.13*	*0.11-0.16*	*50*	*10*	*0.05*	*0.04-0.06*	*35*	*7*	*0.03*	*0.02-0.05*	*27*	*5*	*0.03*	*0.02-0.04*
Atypical teratoid rhabdoid tumor	*380*	*76*	*0.09*	*0.08-0.10*	*325*	*65*	*0.33*	*0.29-0.37*	*33*	*7*	*0.03*	*0.02-0.05*	*16*	*3*	*0.02*	*0.01-0.03*	--	--	--	--
Other embryonal histologies	*220*	*44*	*0.05*	*0.05-0.06*	*160*	*32*	*0.16*	*0.14-0.19*	*25*	*5*	*0.02*	*0.02-0.04*	*16*	*3*	*0.02*	*0.01-0.03*	*19*	*4*	*0.02*	*0.01-0.03*
Tumors of Cranial and Spinal Nerves	**1,291**	**258**	**0.32**	**0.30-0.33**	**290**	**58**	**0.29**	**0.26-0.33**	**246**	**49**	**0.24**	**0.21-0.27**	**304**	**61**	**0.30**	**0.26-0.33**	**451**	**90**	**0.43**	**0.39-0.47**
Nerve Sheath Tumors	1,288	258	0.31	0.30-0.33	290	58	0.29	0.26-0.33	246	49	0.24	0.21-0.27	304	61	0.30	0.26-0.33	448	90	0.43	0.39-0.47
Malignant	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Non-Malignant	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Other Tumors of Cranial and Spinal Nerves	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Tumors of Meninges	**1,133**	**227**	**0.28**	**0.26-0.29**	**204**	**41**	**0.21**	**0.18-0.24**	**134**	**27**	**0.13**	**0.11-0.16**	**254**	**51**	**0.25**	**0.22-0.28**	**541**	**108**	**0.52**	**0.47-0.56**
Meningioma	649	130	0.16	0.15-0.17	72	14	0.07	0.06-0.09	77	15	0.08	0.06-0.09	157	31	0.15	0.13-0.18	343	69	0.33	0.29-0.36
Malignant	*34*	*7*	*0.01*	*0.01-0.01*	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Non-Malignant	*615*	*123*	*0.15*	*0.14-0.16*	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Mesenchymal Tumors	267	53	0.07	0.06-0.07	125	25	0.13	0.11-0.15	50	10	0.05	0.04-0.06	48	10	0.05	0.03-0.06	44	9	0.04	0.03-0.06
Primary Melanocytic Lesions	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Other Neoplasms Related to the Meninges	205	41	0.05	0.04-0.06	--	--	--	--	--	--	--	--	46	9	0.04	0.03-0.06	150	30	0.14	0.12-0.17
Lymphoma and Hematopoietic Neoplasms	***122***	***24***	***0.03***	***0.02-0.04***	***17***	***3***	***0.02***	***0.01-0.03***	***33***	***7***	***0.03***	***0.02-0.05***	***28***	***6***	***0.03***	***0.02-0.04***	***44***	***9***	***0.04***	***0.03-0.06***
Lymphoma	59	12	0.01	0.01-0.02	--	--	--	--	--	--	--	--	--	--	--	--	---	--	--	--
Other Hematopoietic Neoplasms	63	13	0.02	0.01-0.02	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Germ Cell Tumors and Cysts	**993**	**199**	**0.24**	**0.23-0.26**	**184**	**37**	**0.19**	**0.16-0.22**	**165**	**33**	**0.16**	**0.14-0.19**	**345**	**69**	**0.34**	**0.30-0.37**	**299**	**60**	**0.29**	**0.25-0.32**
Germ Cell Tumors, Cysts and Heterotopias	993	199	0.24	0.23-0.26	184	37	0.19	0.16-0.22	165	33	0.16	0.14-0.19	345	69	0.34	0.30-0.37	299	60	0.29	0.25-0.32
Malignant	*775*	*155*	*0.19*	*0.18-0.20*	*80*	*16*	*0.08*	*0.06-0.10*	*120*	*24*	*0.12*	*0.10-0.14*	*308*	*62*	*0.30*	*0.27-0.34*	*267*	*53*	*0.25*	*0.22-0.29*
Non-Malignant	*218*	*44*	*0.05*	*0.05-0.06*	*104*	*21*	*0.11*	*0.09-0.13*	*45*	*9*	*0.04*	*0.03-0.06*	*37*	*7*	*0.04*	*0.03-0.05*	*32*	*6*	*0.03*	*0.02-0.04*

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 Sellar Region	***4,254***	***851***	***1.03***	***1.00-1.07***	***197***	***39***	***0.20***	***0.17-0.23***	***610***	***122***	***0.60***	***0.55-0.65***	***908***	***182***	***0.88***	***0.83-0.94***	***2,539***	***508***	***2.42***	***2.33-2.52***
Tumors of the Pituitary	3,393	679	0.82	0.79-0.85	40	8	0.04	0.03-0.06	304	61	0.30	0.27-0.33	685	137	0.67	0.62-0.72	2,364	473	2.25	2.16-2.35
Malignant	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Non-Malignant	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Craniopharyngioma	861	172	0.21	0.20-0.23	157	31	0.16	0.13-0.19	306	61	0.30	0.27-0.34	223	45	0.22	0.19-0.25	175	35	0.17	0.14-0.19
Unclassified Tumors	**1,510**	**302**	**0.37**	**0.35-0.39**	**338**	**68**	**0.34**	**0.31-0.38**	**300**	**60**	**0.30**	**0.26-0.33**	**397**	**79**	**0.39**	**0.35-0.43**	**475**	**95**	**0.45**	**0.41-0.50**
Hemangioma	598	120	0.15	0.13-0.16	126	25	0.13	0.11-0.15	101	20	0.10	0.08-0.12	147	29	0.14	0.12-0.17	224	45	0.21	0.19-0.24
Neoplasm Unspecified	872	174	0.21	0.20-0.23	195	39	0.20	0.17-0.23	192	38	0.19	0.16-0.22	241	48	0.23	0.21-0.27	244	49	0.23	0.20-0.26
Malignant	*218*	*44*	*0.05*	*0.05-0.06*	*73*	*15*	*0.07*	*0.06-0.09*	*51*	*10*	*0.05*	*0.04-0.07*	*40*	*8*	*0.04*	*0.03-0.05*	*54*	*11*	*0.05*	*0.04-0.07*
Non-Malignant	*654*	*131*	*0.16*	*0.15-0.17*	*122*	*24*	*0.12*	*0.10-0.15*	*141*	*28*	*0.14*	*0.12-0.16*	*201*	*40*	*0.20*	*0.17-0.22*	*190*	*38*	*0.18*	*0.16-0.21*
All Other	40	8	0.01	0.01-0.01	17	3	0.02	0.01-0.03	--	--	--	--	--	--	--	--	--	--	--	--
TOTAL[c]	**25,105**	**5,021**	**6.14**	**6.07-6.22**	**6,105**	**1,221**	**6.18**	**6.02-6.33**	**5,585**	**1,117**	**5.49**	**5.35-5.64**	**5,983**	**1,197**	**5.83**	**5.68-5.98**	**7,432**	**1,486**	**7.09**	**6.93-7.25**
Malignant	***14,463***	***2,893***	***3.55***	***3.49-3.61***	***4,498***	***900***	***4.55***	***4.42-4.68***	***3,847***	***769***	***3.78***	***3.67-3.91***	***3,393***	***679***	***3.31***	***3.19-3.42***	***2,725***	***545***	***2.60***	***2.50-2.70***
Non-Malignant	***10,642***	***2,128***	***2.60***	***2.55-2.65***	***1,607***	***321***	***1.63***	***1.55-1.71***	***1,738***	***348***	***1.71***	***1.63-1.79***	***2,590***	***518***	***2.52***	***2.43-2.62***	***4,707***	***941***	***4.49***	***4.36-4.62***

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 20 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 7. Five-Year Total, Average Annual Age-Adjusted and Age-Specific Incidence Rates[a] with 95% Confidence Intervals for Adults (Age 20+ 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, 2013-2017

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**	**3.27-3.40**	**4.47**	**4.37-4.56**	**6.71**	**6.61-6.82**	**11.30**	**11.16-11.45**	**16.79**	**16.57-17.01**	**19.26**	**18.93-19.59**	**12.03**	**11.65-12.42**
Pilocytic Astrocytoma	0.21	0.20-0.23	0.13	0.11-0.14	0.09	0.08-0.11	0.07	0.06-0.08	0.07	0.05-0.08	0.05	0.04-0.07	--	--
Diffuse Astrocytoma	0.49	0.46-0.51	0.50	0.46-0.53	0.47	0.44-0.50	0.56	0.53-0.59	0.77	0.72-0.81	0.82	0.75-0.89	0.47	0.40-0.55
Anaplastic Astrocytoma	0.38	0.36-0.40	0.50	0.47-0.53	0.51	0.48-0.54	0.68	0.65-0.72	0.90	0.85-0.95	0.93	0.86-1.00	0.41	0.34-0.49
Unique Astrocytoma Variants	0.07	0.06-0.08	0.04	0.03-0.05	0.03	0.03-0.04	0.04	0.03-0.05	0.06	0.05-0.08	0.08	0.06-0.11	0.07	0.04-0.11
Malignant	*0.05*	*0.04-0.06*	*0.04*	*0.03-0.04*	*0.03*	*0.02-0.03*	*0.04*	*0.03-0.05*	*0.06*	*0.05-0.07*	*0.08*	*0.06-0.11*	*0.07*	*0.04-0.10*
Non-Malignant	*0.02*	*0.01-0.02*	*0.01*	*0.00-0.01*	*0.01*	*0.00-0.01*	--	--	--	--	--	--	--	--
Glioblastoma	0.47	0.45-0.49	1.27	1.22-1.32	3.60	3.53-3.69	8.06	7.94-8.18	13.00	12.81-13.20	15.30	15.01-15.59	9.01	8.68-9.35
Oligodendroglioma	0.28	0.26-0.30	0.43	0.40-0.46	0.38	0.36-0.41	0.27	0.25-0.30	0.19	0.17-0.22	0.14	0.11-0.17	0.06	0.04-0.10
Anaplastic Oligodendroglioma	0.10	0.09-0.11	0.18	0.17-0.20	0.21	0.19-0.23	0.19	0.18-0.21	0.16	0.14-0.18	0.12	0.09-0.14	--	--
Oligoastrocytic Tumors	0.14	0.12-0.15	0.17	0.15-0.19	0.14	0.12-0.15	0.11	0.10-0.13	0.11	0.09-0.13	0.07	0.05-0.09	--	--
Ependymal Tumors	0.35	0.33-0.37	0.52	0.49-0.55	0.55	0.52-0.59	0.56	0.53-0.60	0.60	0.56-0.64	0.40	0.36-0.45	0.12	0.08-0.16
Malignant	*0.18*	*0.17-0.20*	*0.27*	*0.25-0.29*	*0.29*	*0.27-0.31*	*0.30*	*0.28-0.32*	*0.32*	*0.29-0.35*	*0.23*	*0.19-0.26*	*0.06*	*0.04-0.10*
Non-Malignant	*0.17*	*0.15-0.18*	*0.25*	*0.23-0.27*	*0.27*	*0.25-0.29*	*0.26*	*0.24-0.29*	*0.28*	*0.25-0.31*	*0.18*	*0.15-0.21*	*0.05*	*0.03-0.09*
Glioma Malignant, NOS	0.29	0.27-0.31	0.28	0.25-0.30	0.33	0.31-0.36	0.39	0.37-0.42	0.60	0.56-0.64	1.08	1.00-1.16	1.70	1.56-1.86
Choroid Plexus Tumors	0.04	0.03-0.05	0.04	0.03-0.05	0.03	0.02-0.03	0.04	0.03-0.05	0.03	0.02-0.04	0.04	0.03-0.06	--	--
Malignant	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Non-Malignant	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Other Neuroepithelial Tumors	0.01	0.00-0.01	0.01	0.00-0.01	--	--	--	--	--	--	--	--	--	--
Malignant	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Non-Malignant	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Neuronal and Mixed Neuronal Glial Tumors	0.33	0.31-0.35	0.26	0.24-0.28	0.25	0.23-0.27	0.22	0.20-0.24	0.21	0.19-0.24	0.16	0.14-0.20	0.08	0.05-0.12
Malignant	*0.03*	*0.03-0.04*	*0.06*	*0.05-0.07*	*0.08*	*0.07-0.10*	*0.10*	*0.08-0.11*	*0.11*	*0.09-0.13*	*0.10*	*0.07-0.12*	*0.07*	*0.04-0.10*
Non-Malignant	*0.29*	*0.27-0.31*	*0.20*	*0.18-0.22*	*0.17*	*0.15-0.18*	*0.12*	*0.11-0.14*	*0.10*	*0.09-0.12*	*0.07*	*0.05-0.09*	--	--
Tumors of the Pineal Region	0.06	0.05-0.06	0.05	0.04-0.06	0.05	0.04-0.06	0.04	0.04-0.05	0.05	0.04-0.06	0.02	0.01-0.04	--	--
Malignant	*0.03*	*0.03-0.04*	*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*	*0.02-0.04*	*0.03*	*0.02-0.03*	*0.02*	*0.02-0.03*	*0.03*	*0.02-0.04*	--	--	--	--

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
Embryonal Tumors	0.15	0.14-0.16	0.09	0.08-0.10	0.05	0.04-0.06	0.05	0.04-0.06	0.03	0.02-0.04	0.04	0.03-0.06	--	--
Tumors of Cranial and Spinal Nerves	**0.95**	**0.91-0.98**	**2.15**	**2.08-2.21**	**3.27**	**3.19-3.35**	**4.49**	**4.40-4.58**	**5.33**	**5.20-5.45**	**4.20**	**4.04-4.35**	**1.85**	**1.70-2.00**
Nerve Sheath Tumors	0.94	0.91-0.98	2.14	2.08-2.21	3.27	3.19-3.34	4.49	4.39-4.58	5.32	5.20-5.44	4.19	4.04-4.35	1.85	1.70-2.00
Malignant	*0.01*	*0.01-0.01*	*0.02*	*0.01-0.02*	*0.02*	*0.01-0.03*	*0.02*	*0.01-0.02*	*0.04*	*0.03-0.05*	*0.02*	*0.01-0.04*	--	--
Non-Malignant	*0.94*	*0.90-0.97*	*2.13*	*2.06-2.19*	*3.25*	*3.17-3.32*	*4.47*	*4.38-4.56*	*5.28*	*5.16-5.41*	*4.17*	*4.02-4.33*	*1.82*	*1.67-1.98*
Other Tumors of Cranial and Spinal Nerves	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Tumors of Meninges	**1.71**	**1.67-1.76**	**5.81**	**5.70-5.91**	**10.92**	**10.78-11.06**	**16.93**	**16.75-17.11**	**29.54**	**29.25-29.84**	**43.77**	**43.28-44.26**	**55.23**	**54.41-56.06**
Meningioma	1.46	1.42-1.50	5.49	5.39-5.60	10.55	10.41-10.68	16.51	16.33-16.68	29.08	28.79-29.37	43.33	42.84-43.82	55.08	54.26-55.91
Malignant	*0.02*	*0.02-0.03*	*0.05*	*0.04-0.06*	*0.10*	*0.09-0.12*	*0.21*	*0.19-0.23*	*0.33*	*0.30-0.36*	*0.44*	*0.39-0.49*	*0.49*	*0.42-0.57*
Non-Malignant	*1.44*	*1.40-1.48*	*5.44*	*5.34-5.54*	*10.45*	*10.31-10.58*	*16.30*	*16.12-16.47*	*28.75*	*28.46-29.04*	*42.89*	*42.41-43.38*	*54.59*	*53.77-55.42*
Mesenchymal Tumors	0.06	0.05-0.07	0.08	0.07-0.10	0.12	0.10-0.13	0.13	0.11-0.14	0.14	0.12-0.16	0.15	0.12-0.18	0.07	0.04-0.10
Primary Melanocytic Lesions	--	--	--	--	0.01	0.00-0.01	0.02	0.01-0.02	0.01	0.01-0.02	--	--	--	--
Other Neoplasms Related to the Meninges	0.19	0.17-0.20	0.22	0.20-0.25	0.25	0.23-0.27	0.28	0.26-0.31	0.31	0.28-0.34	0.27	0.23-0.31	0.07	0.05-0.11
Lymphomas and Hematopoietic Neoplasms	**0.10**	**0.09-0.11**	**0.21**	**0.19-0.23**	**0.41**	**0.38-0.43**	**0.89**	**0.85-0.93**	**1.87**	**1.80-1.95**	**2.43**	**2.31-2.55**	**1.26**	**1.14-1.39**
Lymphoma	0.09	0.08-0.10	0.20	0.18-0.22	0.39	0.37-0.42	0.88	0.83-0.92	1.85	1.77-1.92	2.41	2.29-2.53	1.24	1.12-1.37
Other Hematopoietic Neoplasms	0.01	0.01-0.01	0.01	0.01-0.02	0.01	0.01-0.02	0.02	0.01-0.02	0.03	0.02-0.04	--	--	--	--
Germ Cell Tumors and Cysts	**0.11**	**0.10-0.12**	**0.03**	**0.03-0.04**	**0.03**	**0.02-0.03**	**0.02**	**0.02-0.03**	**0.02**	**0.02-0.03**	**--**	**--**	**--**	**--**
Germ Cell Tumors, Cysts and Heterotopias	0.11	0.10-0.12	0.03	0.03-0.04	0.03	0.02-0.03	0.02	0.02-0.03	0.02	0.02-0.03	--	--	--	--
Malignant	*0.08*	*0.07-0.09*	*0.01*	*0.00-0.01*	--	--	--	--	--	--	--	--	--	--
Non-Malignant	*0.03*	*0.02-0.03*	*0.03*	*0.02-0.03*	*0.02*	*0.02-0.03*	*0.02*	*0.01-0.03*	*0.02*	*0.01-0.03*	--	--	--	--
Tumors of Sellar Region	**4.05**	**3.99-4.12**	**5.64**	**5.53-5.74**	**5.71**	**5.61-5.81**	**6.58**	**6.47-6.69**	**8.35**	**8.19-8.50**	**8.54**	**8.33-8.76**	**5.31**	**5.06-5.58**
Tumors of the Pituitary	3.94	3.87-4.01	5.46	5.36-5.56	5.50	5.40-5.60	6.32	6.21-6.43	8.07	7.92-8.22	8.33	8.11-8.54	5.23	4.98-5.49
Malignant	--	--	*0.01*	*0.01-0.02*	*0.01*	*0.01-0.02*	*0.02*	*0.01-0.03*	*0.02*	*0.01-0.02*	*0.02*	*0.01-0.04*	--	--
Non-Malignant	*3.94*	*3.87-4.01*	*5.45*	*5.35-5.55*	*5.48*	*5.38-5.58*	*6.30*	*6.19-6.41*	*8.05*	*7.90-8.21*	*8.30*	*8.09-8.52*	*5.23*	*4.98-5.49*
Craniopharyngioma	0.11	0.10-0.13	0.18	0.16-0.20	0.21	0.19-0.23	0.26	0.24-0.29	0.28	0.25-0.31	0.22	0.18-0.25	0.08	0.05-0.12

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
Unclassified Tumors	**0.56**	**0.53-0.59**	**0.82**	**0.78-0.86**	**1.07**	**1.02-1.11**	**1.46**	**1.41-1.51**	**2.39**	**2.31-2.47**	**4.74**	**4.58-4.91**	**10.56**	**10.20-10.93**
Hemangioma	0.28	0.26-0.30	0.40	0.37-0.43	0.45	0.42-0.48	0.51	0.48-0.55	0.59	0.55-0.63	0.66	0.60-0.72	0.49	0.42-0.58
Neoplasm Unspecified	0.28	0.26-0.30	0.42	0.39-0.45	0.61	0.58-0.65	0.93	0.89-0.98	1.77	1.70-1.84	4.03	3.89-4.18	9.98	9.63-10.34
Malignant	*0.06*	*0.05-0.07*	*0.11*	*0.09-0.12*	*0.20*	*0.18-0.22*	*0.42*	*0.40-0.45*	*0.88*	*0.83-0.93*	*2.29*	*2.18-2.40*	*6.05*	*5.78-6.33*
Non-Malignant	*0.22*	*0.20-0.23*	*0.31*	*0.29-0.34*	*0.41*	*0.38-0.44*	*0.51*	*0.48-0.54*	*0.89*	*0.84-0.94*	*1.75*	*1.65-1.85*	*3.93*	*3.71-4.15*
All Other	--	--	--	--	--	--	0.01	0.01-0.01	0.03	0.02-0.04	0.05	0.04-0.07	0.09	0.06-0.13
TOTAL[b]	**10.82**	**10.70-10.93**	**19.12**	**18.93-19.32**	**28.11**	**27.89-28.34**	**41.68**	**41.40-41.96**	**64.29**	**63.86-64.73**	**82.96**	**82.28-83.64**	**86.27**	**85.24-87.31**
Malignant	***3.10***	***3.04-3.16***	***4.39***	***4.30-4.48***	***7.03***	***6.91-7.14***	***12.49***	***12.34-12.65***	***19.56***	***19.33-19.80***	***24.25***	***23.88-24.62***	***19.81***	***19.32-20.31***
Non-Malignant	***7.72***	***7.62-7.81***	***14.74***	***14.57-14.90***	***21.08***	***20.89-21.28***	***29.19***	***28.95-29.42***	***44.73***	***44.37-45.09***	***58.71***	***58.14-59.28***	***66.46***	***65.56-67.38***

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 20 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 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[c] and Sex, CBTRUS Statistical Report: U.S. Cancer Statistics – NPCR and SEER, 2013-2017

Site (ICD-O-3 Code)	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)	74,890	14,978	15.3%	4.23	4.20-4.26	41,746	8,349	91.7%	8.3%	4.99	4.94-5.04	33,144	6,629	88.5%	11.5%	3.57	3.53-3.61
Frontal lobe (C71.1)	*32,856*	*6,571*	*7.9%*	*1.88*	*1.86-1.90*	*17,467*	*3,493*	*92.3%*	*7.7%*	*2.11*	*2.07-2.14*	*15,389*	*3,078*	*89.9%*	*10.1%*	*1.68*	*1.65-1.71*
Temporal lobe (C71.2)	*24,233*	*4,847*	*5.8%*	*1.36*	*1.34-1.38*	*14,447*	*2,889*	*90.8%*	*9.2%*	*1.72*	*1.69-1.74*	*9,786*	*1,957*	*86.8%*	*13.2%*	*1.05*	*1.03-1.07*
Parietal lobe (C71.3)	*13,987*	*2,797*	*3.4%*	*0.78*	*0.76-0.79*	*7,706*	*1,541*	*93.4%*	*6.6%*	*0.91*	*0.89-0.93*	*6,281*	*1,256*	*89.1%*	*10.9%*	*0.66*	*0.64-0.68*
Occipital lobe (C71.4)	*3,814*	*763*	*0.9%*	*0.21*	*0.21-0.22*	*2,126*	*425*	*86.4%*	*13.6%*	*0.26*	*0.24-0.27*	*1,688*	*338*	*83.8%*	*16.2%*	*0.18*	*0.17-0.19*
Cerebrum (C71.0)	7,213	1,443	1.7%	0.42	0.41-0.43	3,872	774	83.2%	16.8%	0.47	0.46-0.49	3,341	668	79.5%	20.5%	0.38	0.37-0.39
Ventricle (C71.5)	4,097	819	1.0%	0.26	0.25-0.26	2,218	444	42.1%	57.9%	0.28	0.27-0.29	1,879	376	40.1%	59.9%	0.23	0.22-0.24
Cerebellum (C71.6)	8,892	1,778	2.1%	0.56	0.55-0.57	4,737	947	63.9%	36.1%	0.61	0.59-0.63	4,155	831	55.6%	44.4%	0.52	0.50-0.53
Brain stem (C71.7)	6,174	1,235	1.5%	0.40	0.39-0.41	3,346	669	76.1%	23.9%	0.43	0.42-0.45	2,828	566	77.4%	22.6%	0.37	0.35-0.38
Other brain (C71.8-C71.9)	33,498	6,700	8.1%	1.90	1.88-1.92	17,687	3,537	83.8%	16.2%	2.16	2.12-2.19	15,811	3,162	78.9%	21.1%	1.68	1.65-1.70
Spinal cord and cauda equina (C72.0-C72.1)	12,905	2,581	3.1%	0.77	0.76-0.79	6,782	1,356	27.6%	72.4%	0.84	0.82-0.86	6,123	1,225	26.4%	73.6%	0.71	0.70-0.73
Cranial nerves (C72.2-C72.5)	28,850	5,770	6.9%	1.65	1.63-1.67	13,501	2,700	5.7%	94.3%	1.60	1.57-1.63	15,349	3,070	5.5%	94.5%	1.70	1.67-1.72
Other nervous system (C72.8-C72.9)	2,548	510	0.6%	0.15	0.14-0.15	1,295	259	56.8%	43.2%	0.16	0.15-0.17	1,253	251	55.8%	44.2%	0.14	0.13-0.15
Meninges (cerebral and spinal) (C70.0-C70.9)	159,403	31,881	38.4%	8.84	8.79-8.88	43,365	8,673	2.2%	97.8%	5.30	5.25-5.35	116,038	23,208	1%	99%	11.97	11.90-12.04
Pituitary (C75.1-C75.2)	74,426	14,885	17.9%	4.46	4.42-4.49	33,614	6,723	0.7%	99.3%	4.07	4.03-4.12	40,812	8,162	0.5%	99.5%	4.93	4.88-4.98
Pineal (C75.3)	1,775	355	0.4%	0.11	0.11-0.12	1,040	208	75%	25%	0.13	0.13-0.14	735	147	44.8%	55.2%	0.09	0.09-0.10
Olfactory tumors of the nasal cavity (C30.0[d])	740	148	0.2%	0.04	0.04-0.05	438	88	100%	0%	0.05	0.05-0.06	302	60	100%	0%	0.03	0.03-0.04
TOTAL	**415,411**	**83,082**	**100.0%**	**23.79**	**23.71-23.86**	**173,641**	**34,728**	**39.5%**	**60.5%**	**21.09**	**20.99-21.20**	**241,770**	**48,354**	**22.7%**	**77.3%**	**26.31**	**26.21-26.42**

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. The sites referred to in this table are loosely based on the categories and site codes 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 20 cases were reported for the specific category. The suppressed cases are included in the counts and rates for totals.
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 9. Characteristics of All Brain and Other Central Nervous System Tumors by Central Cancer Registry, Behavior and Diagnostic Confirmation, CBTRUS Statistical Report: U.S. Cancer Statistics – U.S. Cancer Statistics - NPCR and SEER, 2013-2017

State	Total				Malignant				Non-Malignant				Average Annual 2013-2017 5-Year Population[a]
	5-Year Total	Annual Average	Histologically Confirmed[b] (%)	Radiographically Confirmed[c] (%)	5-Year Total	% Malignant	Histologically Confirmed (%)	Radiographically Confirmed (%)	5-Year Total	% Non-Malignant	Histologically Confirmed (%)	Radiographically Confirmed (%)	
Alabama	4,884	977	62.7%	31.3%	1,806	37.0%	80.0%	7.03%	3,078	63.0%	52.6%	45.5%	4,850,769
Alaska	861	172	47.3%	49.1%	253	29.4%	83.0%	11.07%	608	70.6%	32.4%	65.0%	738,563
Arizona	7,702	1,540	63.3%	32.1%	2,467	32.0%	83.7%	7.54%	5,235	68.0%	53.7%	43.6%	6,809,947
Arkansas	3,617	723	53.4%	42.8%	1,225	33.9%	81.6%	11.27%	2,392	66.1%	38.9%	58.9%	2,977,943
California	45,399	9,080	58.9%	36.5%	13,476	29.7%	85.3%	8.45%	31,923	70.3%	47.8%	48.3%	38,982,847
Colorado	7,754	1,551	49.6%	47.5%	2,010	25.9%	81.3%	13.18%	5,744	74.1%	38.5%	59.5%	5,436,514
Connecticut	3,595	719	68.6%	29.2%	1,244	34.6%	88.9%	8.60%	2,351	65.4%	57.8%	40.1%	3,594,478
Delaware	1,053	211	67.1%	29.7%	384	36.5%	84.1%	10.94%	669	63.5%	57.4%	40.5%	943,733
District of Columbia	762	152	60.5%	36.9%	186	24.4%	90.9%	4.30%	576	75.6%	50.7%	47.4%	672,391
Florida	30,477	6,095	52.5%	43.9%	8,503	27.9%	84.5%	10.31%	21,974	72.1%	40.1%	56.9%	20,278,446
Georgia	13,572	2,714	49.1%	46.4%	3,440	25.4%	83.9%	11.37%	10,132	74.7%	37.3%	58.3%	10,201,631
Hawaii	1,221	244	53.3%	39.2%	305	25.0%	84.3%	9.18%	916	75.0%	43.0%	49.2%	1,421,658
Idaho	2,019	404	60.8%	35.9%	703	34.8%	82.4%	13.51%	1,316	65.2%	49.3%	47.9%	1,657,374
Illinois	17,174	3,435	56.3%	41.4%	4,825	28.1%	87.8%	8.06%	12,349	71.9%	44.0%	54.4%	12,854,528
Indiana	7,820	1,564	53.4%	43.1%	2,555	32.7%	84.4%	10.80%	5,265	67.3%	38.4%	58.8%	6,614,417
Iowa	3,482	696	57.5%	39.9%	1,065	30.6%	84.5%	10.80%	2,417	69.4%	45.6%	52.7%	3,118,098
Kansas	3,570	714	53.1%	44.0%	1,072	30.0%	87.7%	9.79%	2,498	70.0%	38.3%	58.7%	2,903,819
Kentucky	6,929	1,386	48.3%	46.4%	1,968	28.4%	78.9%	12.35%	4,961	71.6%	36.2%	59.9%	4,424,379
Louisiana	6,306	1,261	56.2%	38.6%	1,627	25.8%	85.6%	10.20%	4,679	74.2%	46.0%	48.4%	4,663,459
Maine	1,558	312	66.4%	29.9%	681	43.7%	84.0%	9.84%	877	56.3%	52.8%	45.5%	1,330,161
Maryland	7,303	1,461	61.4%	34.3%	2,160	29.6%	86.5%	6.90%	5,143	70.4%	50.8%	45.8%	5,996,078
Massachusetts	7,586	1,517	69.9%	26.1%	2,888	38.1%	87.4%	7.72%	4,698	61.9%	59.2%	37.4%	6,789,321
Michigan	11,946	2,389	58.1%	36.8%	3,921	32.8%	83.9%	7.96%	8,025	67.2%	45.4%	50.9%	9,925,564
Minnesota	6,379	1,276	70.5%	26.2%	2,310	36.2%	87.4%	8.66%	4,069	63.8%	60.8%	36.2%	5,490,723
Mississippi	3,563	713	57.5%	38.8%	1,060	29.8%	86.1%	10.57%	2,503	70.2%	45.4%	50.8%	2,986,222
Missouri	8,130	1,626	54.1%	42.0%	2,500	30.8%	85.7%	8.88%	5,630	69.2%	40.1%	56.7%	6,075,301
Montana	1,471	294	54.7%	41.5%	485	33.0%	82.1%	13.40%	986	67.0%	41.3%	55.3%	1,029,864
Nebraska	2,186	437	58.3%	38.4%	789	36.1%	84.2%	9.51%	1,397	63.9%	43.7%	54.7%	1,893,915
Nevada	3,052	610	57.1%	37.7%	1,075	35.2%	83.1%	8.37%	1,977	64.8%	43.0%	53.7%	2,887,725
New Hampshire	1,752	350	62.9%	34.9%	631	36.0%	91.4%	4.75%	1,121	64.0%	46.8%	51.8%	1,331,850

Table 9. Continued

State	Total				Malignant				Non-Malignant				Average Annual 2013-2017 5-Year Population[a]
	5-Year Total	Annual Average	Histologically Confirmed[b] (%)	Radiographically Confirmed[c] (%)	5-Year Total	% Malignant	Histologically Confirmed (%)	Radiographically Confirmed (%)	5-Year Total	% Non-Malignant	Histologically Confirmed (%)	Radiographically Confirmed (%)	
New Jersey	12,870	2,574	55.1%	40.2%	3,708	28.8%	86.7%	8.79%	9,162	71.2%	42.3%	52.9%	8,960,161
New Mexico	1,679	336	65.0%	28.6%	533	31.8%	86.7%	6.94%	1,146	68.2%	55.0%	38.7%	2,084,827
New York	30,630	6,126	51.6%	45.1%	7,961	26.0%	84.1%	11.15%	22,669	74.0%	40.1%	57.0%	19,798,225
North Carolina	13,440	2,688	54.6%	42.1%	3,819	28.4%	85.3%	9.48%	9,621	71.6%	42.4%	55.1%	10,052,570
North Dakota	812	162	49.5%	47.7%	271	33.4%	82.3%	13.28%	541	66.6%	33.1%	64.9%	745,473
Ohio	13,664	2,733	64.6%	30.9%	4,987	36.5%	85.8%	7.28%	8,677	63.5%	52.4%	44.5%	11,609,755
Oklahoma	4,520	904	55.1%	41.0%	1,494	33.0%	82.5%	9.84%	3,026	67.0%	41.5%	56.4%	3,896,254
Oregon	4,721	944	67.1%	28.6%	1,776	37.6%	83.6%	7.21%	2,945	62.4%	57.1%	41.4%	4,025,128
Pennsylvania	19,748	3,950	50.0%	45.6%	5,829	29.5%	81.5%	10.14%	13,919	70.5%	36.8%	60.5%	12,790,507
Rhode Island	1,172	234	65.5%	30.8%	443	37.8%	87.6%	7.90%	729	62.2%	52.1%	44.7%	1,056,137
South Carolina	6,523	1,305	52.1%	42.9%	1,933	29.6%	83.7%	9.88%	4,590	70.4%	38.7%	56.8%	4,893,447
South Dakota	1,036	207	47.6%	49.2%	332	32.0%	79.2%	15.96%	704	68.0%	32.7%	64.9%	855,442
Tennessee	9,059	1,812	51.8%	45.5%	2,532	27.9%	86.0%	9.72%	6,527	72.0%	38.6%	59.4%	6,597,383
Texas	33,471	6,694	50.1%	43.8%	9,426	28.2%	80.3%	13.24%	24,045	71.8%	38.3%	55.7%	27,419,611
Utah	5,059	1,012	45.4%	53.4%	1,011	20.0%	84.7%	13.25%	4,048	80.0%	35.6%	63.4%	2,993,941
Vermont	913	183	57.9%	39.2%	278	30.4%	89.9%	4.68%	635	69.5%	43.9%	54.3%	624,635
Virginia	8,844	1,769	63.3%	32.8%	3,019	34.1%	85.8%	6.79%	5,825	65.9%	51.6%	46.3%	8,365,952
Washington	12,240	2,448	45.6%	50.1%	3,041	24.8%	81.7%	11.28%	9,199	75.2%	33.7%	63.0%	7,169,967
West Virginia	2,538	508	54.5%	41.9%	824	32.5%	87.0%	9.95%	1,714	67.5%	38.9%	57.2%	1,836,844
Wisconsin	8,675	1,735	49.8%	46.7%	2,427	28.0%	83.4%	11.66%	6,248	72.0%	36.7%	60.4%	5,763,218
Wyoming	674	135	65.1%	33.4%	226	33.5%	87.6%	9.73%	448	66.5%	53.8%	45.3%	583,200
Total	**415,411**	**83,082**	**55.3%**	**40.6%**	**123,484**	**29.7%**	**84.3%**	**9.72%**	**291,927**	**70.3%**	**43.0%**	**53.7%**	**321,004,396**

a. Population estimates were obtained from the United States Bureau of the Census available on the SEER program website.
b. Histologic confirmation includes tumors classified as having diagnosis confirmed by: positive histology, positive cytology, positive histology plus – positive immunophenotyping and/or positive genetic studies, or positive microscopic confirmation, method not specified.
c. Radiographic confirmation includes tumors classified as having diagnosis confirmed by Radiography and/or other imaging techniques without microscopic confirmation.
- 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 Brain and Other Central Nervous System Tumors by Age at Diagnosis, Behavior, and Central Cancer Registry, CBTRUS Statistical Report: U.S. Cancer Statistics – U.S. Cancer Statistics - NPCR and SEER, 2013-2017

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	3.72	3.26-4.24	1.45	1.17-1.78	5.17	4.62-5.77	7.81	7.41-8.21	15.22	14.66-15.79	23.02	22.34-23.72	6.63	6.32-6.96	11.27	10.86-11.69	17.9	17.39-18.43
Alaska	3.2	2.20-4.50	3.55	2.47-4.93	6.76	5.24-8.56	8.43	7.29-9.70	23.32	21.33-25.44	31.75	29.44-34.19	6.93	6.06-7.89	17.65	16.19-19.20	24.58	22.87-26.38
Arizona	2.94	2.59-3.31	2.53	2.21-2.88	5.47	5.00-5.97	7.83	7.50-8.17	18.33	17.81-18.86	26.15	25.54-26.78	6.42	6.17-6.69	13.8	13.42-14.18	20.22	19.76-20.69
Arkansas	3.82	3.23-4.48	2.55	2.07-3.10	6.37	5.60-7.21	8.74	8.22-9.30	19.18	18.38-20.01	27.93	26.97-28.91	7.33	6.92-7.77	14.41	13.82-15.02	21.74	21.02-22.48
California	3.09	2.94-3.25	2.26	2.14-2.40	5.35	5.15-5.56	8.08	7.93-8.23	21.12	20.88-21.36	29.19	28.91-29.48	6.65	6.53-6.76	15.71	15.54-15.89	22.36	22.15-22.57
Colorado	3.42	3.00-3.88	2.47	2.11-2.87	5.89	5.33-6.49	8.54	8.14-8.96	27.48	26.75-28.23	36.02	35.19-36.88	7.07	6.76-7.40	20.31	19.77-20.85	27.38	26.76-28.01
Connecticut	3.79	3.17-4.50	2.62	2.11-3.20	6.41	5.60-7.31	9.15	8.60-9.72	19.24	18.42-20.08	28.39	27.41-29.40	7.61	7.18-8.06	14.47	13.87-15.09	22.08	21.34-22.84
Delaware	4.04	2.96-5.39	2.69	1.83-3.82	6.73	5.31-8.42	8.31	7.42-9.28	16.28	15.00-17.65	24.6	23.02-26.25	7.09	6.37-7.86	12.39	11.43-13.40	19.47	18.27-20.73
District of Columbia	3.98	2.63-5.78	2.84	1.69-4.45	6.82	4.98-9.10	6.46	5.47-7.58	23.53	21.56-25.62	29.99	27.77-32.33	5.75	4.93-6.67	17.59	16.15-19.14	23.34	21.67-25.11
Florida	3.72	3.47-3.98	3.04	2.82-3.27	6.76	6.43-7.11	8.3	8.11-8.49	23.45	23.12-23.78	31.75	31.37-32.13	6.99	6.83-7.14	17.59	17.35-17.84	24.58	24.29-24.87
Georgia	3.52	3.22-3.85	2.88	2.60-3.17	6.4	5.99-6.84	7.79	7.51-8.08	26.1	25.57-26.64	33.89	33.29-34.50	6.57	6.34-6.79	19.44	19.05-19.83	26.01	25.56-26.45
Hawaii	1.64	1.02-2.48	1.83	1.17-2.72	3.47	2.54-4.62	5.94	5.25-6.70	18.88	17.62-20.21	24.82	23.37-26.34	4.71	4.18-5.29	13.99	13.06-14.96	18.7	17.62-19.82
Idaho	3.62	2.90-4.46	2.17	1.62-2.85	5.79	4.87-6.84	9.62	8.85-10.43	20.12	19.00-21.29	29.73	28.37-31.15	7.89	7.31-8.52	14.97	14.15-15.82	22.87	21.86-23.91
Illinois	3.3	3.03-3.59	2.59	2.35-2.85	5.89	5.53-6.28	8.38	8.12-8.64	23.82	23.38-24.26	32.19	31.69-32.70	6.92	6.72-7.12	17.73	17.41-18.05	24.65	24.27-25.03
Indiana	3.15	2.79-3.54	2.32	2.02-2.66	5.47	5.00-5.98	8.73	8.37-9.11	19.59	19.04-20.15	28.32	27.66-28.99	7.13	6.85-7.42	14.63	14.23-15.04	21.76	21.27-22.26
Iowa	3.6	2.98-4.31	3.53	2.92-4.23	7.13	6.25-8.11	9.13	8.54-9.75	22.85	21.90-23.84	31.99	30.86-33.15	7.55	7.09-8.03	17.31	16.60-18.04	24.86	24.01-25.72
Kansas	3.64	3.07-4.28	2.57	2.09-3.11	6.21	5.46-7.03	8.12	7.59-8.68	21.39	20.52-22.29	29.52	28.49-30.57	6.84	6.42-7.27	15.99	15.35-16.65	22.83	22.07-23.61
Kentucky	4.23	3.71-4.80	3.53	3.05-4.05	7.76	7.05-8.52	9.63	9.17-10.11	27.07	26.28-27.87	36.7	35.79-37.63	8.08	7.72-8.46	20.31	19.74-20.90	28.4	27.71-29.09
Louisiana	3.52	3.07-4.02	2.79	2.39-3.24	6.31	5.70-6.97	7.75	7.34-8.18	25.22	24.47-25.99	32.97	32.11-33.84	6.54	6.22-6.87	18.79	18.24-19.35	25.32	24.69-25.97
Maine	4.3	3.29-5.51	1.2	0.71-1.90	5.49	4.35-6.84	10.01	9.20-10.88	14.44	13.43-15.50	24.45	23.15-25.81	8.37	7.72-9.07	10.64	9.91-11.42	19.01	18.02-20.04
Maryland	3.16	2.77-3.59	2.13	1.82-2.49	5.3	4.79-5.84	8.08	7.71-8.46	20.96	20.37-21.57	29.04	28.34-29.75	6.67	6.38-6.96	15.56	15.13-16.00	22.23	21.71-22.76
Massachusetts	3.54	3.13-3.98	2.19	1.88-2.53	5.73	5.21-6.28	9.25	8.88-9.62	16.17	15.69-16.66	25.42	24.81-26.03	7.61	7.32-7.90	12.16	11.80-12.52	19.77	19.31-20.23
Michigan	3.31	2.99-3.64	1.9	1.66-2.15	5.2	4.81-5.62	8.47	8.18-8.76	19.12	18.68-19.56	27.59	27.06-28.12	6.99	6.76-7.22	14.18	13.86-14.50	21.16	20.77-21.56
Minnesota	3.89	3.45-4.38	2.44	2.09-2.83	6.34	5.76-6.95	9.3	8.88-9.72	17.82	17.25-18.40	27.11	26.41-27.83	7.75	7.42-8.08	13.41	12.99-13.84	21.15	20.62-21.69
Mississippi	2.55	2.08-3.09	2.22	1.79-2.73	4.77	4.12-5.49	8.13	7.61-8.68	20.83	19.98-21.70	28.96	27.96-29.98	6.53	6.13-6.94	15.49	14.87-16.12	22.02	21.28-22.77
Missouri	4.15	3.71-4.63	2.22	1.90-2.57	6.37	5.82-6.96	8.64	8.27-9.02	22.25	21.64-22.86	30.89	30.18-31.61	7.35	7.06-7.66	16.5	16.06-16.95	23.86	23.32-24.40
Montana	2.69	1.86-3.76	2.2	1.46-3.18	4.89	3.75-6.27	9.99	9.05-11.01	22.23	20.77-23.76	32.22	30.47-34.03	7.89	7.17-8.67	16.48	15.42-17.60	24.38	23.09-25.72
Nebraska	4	3.27-4.84	2.96	2.34-3.70	6.96	5.98-8.04	9.13	8.44-9.86	18.35	17.35-19.40	27.48	26.26-28.74	7.66	7.12-8.22	13.94	13.19-14.71	21.59	20.67-22.54

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
Nevada	3.48	2.90-4.14	1.88	1.46-2.39	5.36	4.64-6.17	8.16	7.63-8.71	17	16.23-17.80	25.16	24.22-26.12	6.81	6.40-7.25	12.66	12.10-13.25	19.48	18.78-20.20
New Hampshire	4.62	3.59-5.84	2.06	1.42-2.91	6.68	5.44-8.11	9.46	8.66-10.31	18.94	17.78-20.15	28.39	26.98-29.86	8.07	7.42-8.76	14.1	13.25-14.99	22.16	21.09-23.28
New Jersey	3.75	3.40-4.13	3.1	2.78-3.45	6.85	6.37-7.36	9.04	8.73-9.36	24.55	24.03-25.09	33.6	32.99-34.22	7.53	7.28-7.78	18.4	18.02-18.79	25.92	25.47-26.39
New Mexico	2.43	1.82-3.17	1.84	1.32-2.50	4.27	3.45-5.22	7.05	6.41-7.73	16.74	15.74-17.79	23.79	22.59-25.03	5.72	5.23-6.25	12.47	11.73-13.23	18.19	17.30-19.11
New York	4.05	3.80-4.32	4.08	3.83-4.35	8.14	7.78-8.51	8.67	8.47-8.88	27.39	27.01-27.76	36.06	35.63-36.49	7.35	7.18-7.52	20.7	20.43-20.98	28.05	27.73-28.37
North Carolina	3.57	3.25-3.91	2.46	2.20-2.75	6.03	5.61-6.47	8.26	7.98-8.55	23.28	22.80-23.77	31.54	30.98-32.11	6.92	6.69-7.14	17.31	16.96-17.67	24.22	23.81-24.65
North Dakota	3.27	2.25-4.61	2.92	1.94-4.22	6.19	4.73-7.96	8.21	7.17-9.36	18.84	17.18-20.61	27.05	25.08-29.13	6.79	5.99-7.68	14.27	13.05-15.57	21.06	19.59-22.62
Ohio	4.18	3.86-4.53	2.67	2.41-2.95	6.85	6.43-7.29	9	8.72-9.28	17.49	17.10-17.88	26.49	26.01-26.97	7.61	7.40-7.84	13.24	12.95-13.53	20.85	20.49-21.22
Oklahoma	3.45	2.97-3.99	2.1	1.73-2.53	5.55	4.94-6.22	8.45	7.99-8.93	19.43	18.71-20.17	27.88	27.03-28.76	7.02	6.66-7.39	14.46	13.94-15.00	21.48	20.84-22.13
Oregon	4.03	3.48-4.64	2.72	2.27-3.22	6.75	6.04-7.52	9.3	8.83-9.78	17	16.35-17.66	26.29	25.50-27.11	7.79	7.42-8.17	12.9	12.42-13.39	20.69	20.08-21.31
Pennsylvania	4.18	3.86-4.52	2.32	2.09-2.57	6.5	6.10-6.92	9.33	9.07-9.60	24.94	24.50-25.38	34.27	33.76-34.78	7.85	7.64-8.07	18.45	18.13-18.77	26.3	25.92-26.69
Rhode Island	2.68	1.83-3.79	1.86	1.18-2.78	4.54	3.42-5.90	9.03	8.15-9.98	15.93	14.73-17.19	24.95	23.46-26.51	7.21	6.53-7.94	11.89	11.01-12.82	19.09	17.98-20.26
South Carolina	3.31	2.87-3.80	2.45	2.08-2.87	5.76	5.17-6.39	8.37	7.97-8.79	22.13	21.46-22.81	30.5	29.72-31.30	6.92	6.61-7.25	16.49	16.00-16.99	23.41	22.82-24.00
South Dakota	3.37	2.41-4.59	1.71	1.04-2.64	5.08	3.88-6.54	8.36	7.40-9.42	20.37	18.82-22.02	28.73	26.89-30.67	6.93	6.18-7.74	15.02	13.89-16.22	21.95	20.58-23.38
Tennessee	3.5	3.11-3.92	2.63	2.29-3.00	6.13	5.61-6.68	8.29	7.94-8.65	23.97	23.37-24.59	32.26	31.57-32.97	6.92	6.64-7.20	17.85	17.41-18.30	24.77	24.25-25.30
Texas	3.62	3.44-3.81	2.73	2.57-2.90	6.35	6.11-6.60	8.25	8.07-8.43	24.21	23.90-24.53	32.46	32.09-32.83	6.92	6.78-7.06	18.05	17.82-18.28	24.97	24.70-25.24
Utah	3.02	2.55-3.54	3.05	2.58-3.59	6.07	5.40-6.80	9.15	8.54-9.80	42.22	40.88-43.59	51.37	49.89-52.88	7.39	6.93-7.87	30.98	30.02-31.97	38.37	37.30-39.47
Vermont	2.92	1.76-4.55	3.46	2.25-5.11	6.38	4.64-8.56	9.45	8.28-10.74	22.66	20.80-24.64	32.11	29.90-34.45	7.58	6.67-8.58	17.15	15.78-18.63	24.73	23.07-26.49
Virginia	3.36	3.02-3.73	1.83	1.58-2.11	5.19	4.76-5.65	7.98	7.67-8.29	17.09	16.63-17.55	25.07	24.52-25.62	6.65	6.41-6.90	12.71	12.38-13.05	19.36	18.95-19.78
Washington	4.35	3.92-4.80	3.37	3.00-3.77	7.71	7.15-8.31	9.3	8.94-9.67	31.85	31.17-32.53	41.15	40.38-41.92	7.88	7.59-8.17	23.68	23.18-24.18	31.56	30.99-32.13
West Virginia	4.1	3.28-5.06	2.39	1.78-3.14	6.48	5.44-7.66	9.05	8.38-9.76	20.86	19.83-21.94	29.91	28.67-31.19	7.63	7.09-8.20	15.56	14.80-16.35	23.19	22.26-24.16
Wisconsin	2.8	2.43-3.22	2.07	1.76-2.43	4.88	4.38-5.41	9.28	8.89-9.69	26.03	25.36-26.71	35.31	34.53-36.10	7.42	7.12-7.74	19.16	18.67-19.65	26.58	26.01-27.17
Wyoming	--	--	--	--	3.14	2.01-4.67	9.18	7.95-10.56	19.62	17.76-21.61	28.8	26.55-31.19	7.1	6.18-8.13	14.34	12.99-15.78	21.44	19.80-23.18
TOTAL	**3.55**	**3.49-3.61**	**2.6**	**2.55-2.65**	**6.14**	**6.07-6.22**	**8.5**	**8.45-8.55**	**22.38**	**22.30-22.47**	**30.89**	**30.79-30.99**	**7.08**	**7.04-7.12**	**16.71**	**16.64-16.77**	**23.79**	**23.71-23.86**

a. Rates are per 100,000 and are age-adjusted to the 2000 US 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 Histologically-Confirmed Brain and Other Central Nervous System Tumors by WHO Grade Completeness, Treatment Information Completeness, and Major Histology Grouping, CBTRUS Statistical Report: U.S. Cancer Statistics – U.S. Cancer Statistics - NPCR and SEER, 2013-2017

Histology	Number of Newly Diagnosed Tumors (2013-2017)	Histologically Confirmed[a] (%)	WHO Grade Completeness (%)			Assigned WHO Grade				Radiation Information Completeness[c] (%)	Surgical Extent of Resection Information Complete Completeness[d] (%)
			Complete[b]	Incomplete	Not Applicable	I	II	III	IV		
Tumors of Neuroepithelial Tissue	**113,056**	**89.2%**	**87.0%**	**11.5%**	**1.5%**	**10.6%**	**13.7%**	**13.0%**	**62.8%**	**55.4%**	**97.8%**
Pilocytic Astrocytoma	5,167	90.1%	87.9%	11.7%	0.4%	93.9%	5.1%	0.8%	0.3%	5.8%	99.0%
Diffuse Astrocytoma	7,428	92.8%	86.0%	13.8%	0.1%	3.3%	67.5%	17.9%	11.2%	50.1%	97.4%
Anaplastic Astrocytoma	7,116	99.3%	95.6%	4.4%	0.1%	0.1%	1.2%	90.1%	8.6%	77.6%	99.1%
Unique Astrocytoma Variants	1,123	75.4%	77.7%	22.1%	0.2%	21.0%	54.0%	20.1%	5.0%	21.0%	97.8%
Malignant	*769*	*87.3%*	*79.7%*	*20.0%*	*0.3%*	*2.8%*	*66.4%*	*24.7%*	*6.2%*	*30.1%*	*97.5%*
Non-Malignant	*354*	*49.7%*	*69.9%*	*30.1%*	*0.0%*	*100.0%*	*0.0%*	*0.0%*	*0.0%*	*1.8%*	*98.3%*
Glioblastoma	60,056	93.4%	90.5%	9.5%	0.0%	0.2%	0.2%	0.7%	99.0%	69.6%	97.5%
Oligodendroglioma	3,698	96.8%	93.7%	6.3%	0.0%	1.6%	88.3%	6.3%	3.9%	36.9%	98.0%
Anaplastic Oligodendroglioma	1,859	99.1%	95.7%	4.3%	0.0%	0.0%	3.2%	88.8%	8.0%	71.8%	98.8%
Oligoastrocytic Tumors	1,572	99.0%	94.8%	5.2%	0.0%	0.7%	48.3%	42.7%	8.2%	59.7%	99.5%
Ependymal Tumors	6,843	88.4%	87.5%	12.4%	0.1%	36.0%	48.6%	14.5%	0.9%	26.1%	98.5%
Malignant	*3,972*	*93.6%*	*90.2%*	*9.7%*	*0.1%*	*2.5%*	*73.5%*	*22.7%*	*1.3%*	*38.5%*	*98.7%*
Non-Malignant	*2,871*	*81.2%*	*83.1%*	*16.8%*	*0.0%*	*93.9%*	*5.6%*	*0.3%*	*0.3%*	*8.7%*	*98.2%*
Glioma Malignant, NOS	*8,093*	*36.3%*	*50.9%*	*48.0%*	*1.1%*	*15.0%*	*26.7%*	*22.4%*	*35.9%*	*28.2%*	*97.4%*
Choroid Plexus Tumors	827	88.0%	77.2%	22.8%	0.0%	64.2%	19.3%	15.9%	0.7%	4.7%	98.1%
Malignant	*128*	*97.7%*	*80.8%*	*19.2%*	*0.0%*	*5.0%*	*3.0%*	*88.1%*	*4.0%*	*15.0%*	*100.0%*
Non-Malignant	*699*	*86.3%*	*76.4%*	*23.6%*	*0.0%*	*77.2%*	*22.8%*	*0.0%*	*0.0%*	*2.8%*	*97.8%*
Other Neuroepithelial Tumors	107	94.4%	57.4%	41.6%	1.0%	8.6%	55.2%	24.1%	12.1%	39.4%	97.5%
Malignant	*66*	*98.5%*	*47.7%*	*50.8%*	*1.5%*	*9.7%*	*22.6%*	*45.2%*	*22.6%*	*54.1%*	*96.0%*
Non-Malignant	*41*	*87.8%*	*75.0%*	*25.0%*	*0.0%*	*7.4%*	*92.6%*	*0.0%*	*0.0%*	*15.8%*	*100.0%*
Neuronal and Mixed Neuronal Glial Tumors	4,934	92.2%	65.4%	18.1%	16.5%	81.0%	15.1%	3.2%	0.6%	15.5%	98.4%
Malignant	*947*	*98.5%*	*16.5%*	*4.8%*	*78.7%*	*28.6%*	*9.1%*	*55.2%*	*7.1%*	*61.7%*	*97.4%*
Non-Malignant	*3,987*	*90.7%*	*78.0%*	*21.5%*	*0.5%*	*83.9%*	*15.5%*	*0.4%*	*0.3%*	*4.7%*	*98.6%*

Table 11. Continued

Histology	Number of Newly Diagnosed Tumors (2013-2017)	Histologically Confirmed[a] (%)	WHO Grade Completeness (%)			Assigned WHO Grade				Radiation Information Completeness[c] (%)	Surgical Extent of Resection Information Complete Completeness[d] (%)
			Complete[b]	Incomplete	Not Applicable	I	II	III	IV		
Tumors of the Pineal Region	**787**	**77.5%**	**0.0%**	**0.0%**	**100.0%**	--	--	--	--	**40.9%**	**98.3%**
Malignant	*447*	*96.9%*	*0.0%*	*0.0%*	*100.0%*	--	--	--	--	*66.3%*	*98.1%*
Non-Malignant	*340*	*52.1%*	*0.0%*	*0.0%*	*100.0%*	--	--	--	--	*8.6%*	*98.4%*
Embryonal Tumors	**3,446**	**98.1%**	**77.5%**	**21.7%**	**0.7%**	**1.3%**	**0.2%**	**1.5%**	**97.1%**	**62.8%**	**97.6%**
Tumors of Cranial and Spinal Nerves	**35,600**	**49.7%**	**36.4%**	**63.6%**	**0.0%**	**99.2%**	**0.5%**	**0.2%**	**0.2%**	**17.4%**	**98.3%**
Nerve Sheath Tumors	35,560	49.7%	36.4%	63.6%	0.0%	99.2%	0.5%	0.2%	0.2%	17.4%	98.3%
Malignant	*223*	*78.9%*	*22.7%*	*77.3%*	*0.0%*	*57.5%*	*15.0%*	*15.0%*	*12.5%*	*34.7%*	*85.7%*
Non-Malignant	*35,337*	*49.6%*	*36.5%*	*63.5%*	*0.0%*	*99.4%*	*0.4%*	*0.1%*	*0.1%*	*17.3%*	*98.3%*
Other Tumors of Cranial and Spinal Nerves	40	42.5%	23.5%	76.5%	0.0%	100.0%	0.0%	0.0%	0.0%	2.5%	100.0%
Tumors of Meninges	**163,619**	**40.1%**	**79.9%**	**20.1%**	**0.1%**	**80.1%**	**17.7%**	**2.1%**	**0.2%**	**7.2%**	**97.7%**
Meningioma	159,038	38.8%	81.3%	18.7%	0.0%	80.3%	17.9%	1.6%	0.1%	6.9%	97.6%
Malignant	*1,750*	*79.2%*	*85.3%*	*14.6%*	*0.1%*	*21.2%*	*17.2%*	*60.6%*	*1.1%*	*38.8%*	*84.9%*
Non-Malignant	*157,288*	*38.3%*	*81.2%*	*18.8%*	*0.0%*	*81.7%*	*18.0%*	*0.2%*	*0.1%*	*6.6%*	*97.7%*
Mesenchymal Tumors	1,462	74.7%	55.7%	43.8%	0.5%	9.4%	43.3%	42.9%	4.4%	32.4%	98.1%
Primary Melanocytic Lesions	108	88.9%	12.5%	82.3%	5.2%	58.3%	33.3%	0.0%	8.3%	45.4%	94.7%
Other Neoplasms Related to the Meninges	3,011	91.9%	59.1%	39.9%	1.0%	99.3%	0.4%	0.1%	0.2%	6.9%	98.4%
Lymphoma and Hematopoietic Neoplasms	**8,150**	**94.9%**	**7.7%**	**90.7%**	**1.6%**	**100.0%**	**0.0%**	**0.0%**	**0.0%**	**20.7%**	**99.1%**
Lymphoma	*7,919*	*95.0%*	*8.0%*	*91.3%*	*0.7%*	*100.0%*	*0.0%*	*0.0%*	*0.0%*	*20.3%*	*99.1%*
Other Hematopoietic Neoplasms	*231*	*88.7%*	*0.9%*	*79.6%*	*19.5%*	*100.0%*	*0.0%*	*0.0%*	*0.0%*	*33.5%*	*99.2%*
Germ Cell Tumors and Cysts	**1,585**	**81.1%**	**3.8%**	**53.7%**	**42.5%**	**18.4%**	**6.1%**	**6.1%**	**69.4%**	**47.9%**	**98.2%**
Germ Cell Tumors, Cysts and Heterotopias	*1,585*	*81.1%*	*3.8%*	*53.7%*	*42.5%*	*18.4%*	*6.1%*	*6.1%*	*69.4%*	*47.9%*	*98.2%*
Malignant	*1,095*	*88.0%*	*4.4%*	*42.5%*	*53.1%*	*4.8%*	*7.1%*	*7.1%*	*81.0%*	*67.9%*	*98.9%*
Non-Malignant	*490*	*65.7%*	*2.2%*	*87.0%*	*10.9%*	*100.0%*	*0.0%*	*0.0%*	*0.0%*	*2.8%*	*96.6%*

Table 11. Continued

Histology	Number of Newly Diagnosed Tumors (2013-2017)	Histologically Confirmed[a] (%)	WHO Grade Completeness (%)			Assigned WHO Grade				Radiation Information Completeness[c] (%)	Surgical Extent of Resection Information Complete Completeness[d] (%)
			Complete[b]	Incomplete	Not Applicable	I	II	III	IV		
Tumors of Sellar Region	**73,340**	**46.9%**	**0.5%**	**0.5%**	**99.0%**	**100.0%**	**0.0%**	**0.0%**	**0.0%**	**3.0%**	**97.7%**
Tumors of the Pituitary	70,211	45.2%	0.0%	0.0%	100.0%	--	--	--	--	2.2%	97.7%
Malignant	*142*	*66.9%*	*0.0%*	*0.0%*	*100.0%*	--	--	--	--	*19.2%*	*84.8%*
Non-Malignant	*70,069*	*45.2%*	*0.0%*	*0.0%*	*100.0%*	--	--	--	--	*2.2%*	*97.7%*
Craniopharyngioma	3,129	84.0%	6.4%	6.5%	87.1%	100.0%	0.0%	0.0%	0.0%	22.0%	97.9%
Unclassified Tumors	**20,061**	**17.4%**	**4.7%**	**87.0%**	**8.3%**	**63.6%**	**9.1%**	**9.7%**	**17.6%**	**3.9%**	**69.8%**
Hemangioma	5,731	29.6%	2.5%	97.1%	0.4%	88.4%	7.0%	4.7%	0.0%	2.2%	97.6%
Neoplasm Unspecified	14,136	12.2%	6.4%	78.0%	15.6%	56.4%	10.9%	10.9%	21.8%	4.8%	59.9%
Malignant	*6,587*	*8.2%*	*8.5%*	*85.8%*	*5.7%*	*17.4%*	*13.0%*	*23.9%*	*45.7%*	*9.0%*	*42.5%*
Non-Malignant	*7,549*	*15.6%*	*5.4%*	*74.5%*	*20.1%*	*84.4%*	*9.4%*	*1.6%*	*4.7%*	*2.8%*	*75.7%*
All Other	194	37.6%	16.4%	63.0%	20.5%	41.7%	0.0%	16.7%	41.7%	10.6%	92.1%
TOTAL	**415,411**	**55.6%**	**65.2%**	**18.7%**	**16.1%**	**39.5%**	**14.5%**	**8.5%**	**37.5%**	**21.0%**	**95.9%**
Malignant	***123,484***	***85.5%***	***83.9%***	***14.1%***	***2.0%***	***6.0%***	***13.8%***	***14.6%***	***65.5%***	***55.1%***	***92.1%***
Non-Malignant	***291,927***	***43.0%***	***50.2%***	***22.4%***	***27.4%***	***84.1%***	***15.4%***	***0.3%***	***0.1%***	***6.8%***	***97.1%***

a. Histologic confirmation includes tumors classified as diagnosis confirmed by: positive histology, positive cytology, positive histology plus – positive immunophenotyping and/or positive genetic studies, or positive microscopic confirmation, method not specified.
b. 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.
c. 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.'
d. 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 Brain and Other Central Nervous System Tumors by Major Histology Grouping, Histology, and Race[c], CBTRUS Statistical Report: U.S. Cancer Statistics – U.S. Cancer Statistics - NPCR and SEER, 2013-2017

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	**99,024**	**19,805**	**7.10**	**7.06-7.15**	**8,501**	**1,700**	**3.92**	**3.84-4.01**	**632**	**126**	**3.10**	**2.85-3.37**	**2,561**	**512**	**2.69**	**2.59-2.80**
Pilocytic Astrocytoma	4,195	839	0.38	0.37-0.39	621	124	0.26	0.24-0.29	35	7	0.14	0.10-0.19	120	24	0.13	0.11-0.16
Diffuse Astrocytoma	6,406	1,281	0.49	0.48-0.50	592	118	0.27	0.25-0.29	59	12	0.28	0.21-0.36	191	38	0.20	0.17-0.23
Anaplastic Astrocytoma	6,300	1,260	0.47	0.45-0.48	466	93	0.22	0.20-0.24	38	8	0.18	0.12-0.25	189	38	0.19	0.16-0.22
Unique Astrocytoma Variants	896	179	0.07	0.07-0.08	142	28	0.06	0.05-0.07	--	--	--	--	47	9	0.05	0.04-0.07
Malignant	*639*	*128*	*0.05*	*0.05-0.06*	*76*	*15*	*0.03*	*0.03-0.04*	--	--	--	--	*31*	*6*	*0.03*	*0.02-0.04*
Non-Malignant	*257*	*51*	*0.02*	*0.02-0.03*	*66*	*13*	*0.03*	*0.02-0.04*	--	--	--	--	*16*	*3*	*0.02*	*0.01-0.03*
Glioblastoma	54,211	10,842	3.51	3.48-3.54	3,683	737	1.77	1.71-1.83	264	53	1.49	1.30-1.69	1,107	221	1.18	1.11-1.25
Oligodendroglioma	3,242	648	0.26	0.25-0.27	244	49	0.12	0.10-0.13	29	6	0.13	0.09-0.19	85	17	0.08	0.07-0.10
Anaplastic Oligodendroglioma	1,627	325	0.12	0.12-0.13	102	20	0.05	0.04-0.06	--	--	--	--	67	13	0.07	0.05-0.09
Oligoastrocytic Tumors	1,398	280	0.11	0.11-0.12	85	17	0.04	0.03-0.05	--	--	--	--	43	9	0.04	0.03-0.06
Ependymal Tumors	5,837	1,167	0.46	0.45-0.47	576	115	0.26	0.24-0.28	41	8	0.18	0.13-0.25	179	36	0.18	0.16-0.21
Malignant	*3,316*	*663*	*0.26*	*0.25-0.27*	*381*	*76*	*0.17*	*0.15-0.19*	*18*	*4*	*0.08*	*0.05-0.12*	*129*	*26*	*0.13*	*0.11-0.16*
Non-Malignant	*2,521*	*504*	*0.19*	*0.19-0.20*	*195*	*39*	*0.09*	*0.08-0.10*	*23*	*5*	*0.11*	*0.07-0.16*	*50*	*10*	*0.05*	*0.04-0.07*
Glioma Malignant, NOS	*6,703*	*1,341*	*0.53*	*0.52-0.54*	*881*	*176*	*0.40*	*0.37-0.43*	*55*	*11*	*0.26*	*0.19-0.34*	*205*	*41*	*0.22*	*0.19-0.25*
Choroid Plexus Tumors	697	139	0.06	0.05-0.06	72	14	0.03	0.02-0.04	--	--	--	--	--	--	--	--
Malignant	*99*	*20*	*0.01*	*0.01-0.01*	*18*	*4*	*0.01*	*0.00-0.01*	--	--	--	--	--	--	--	--
Non-Malignant	*598*	*120*	*0.05*	*0.05-0.05*	*54*	*11*	*0.02*	*0.02-0.03*	--	--	--	--	--	--	--	--
Other Neuroepithelial Tumors	81	16	0.01	0.01-0.01	--	--	--	--	--	--	--	--	--	--	--	--
Malignant	*48*	*10*	*0.00*	*0.00-0.01*	--	--	--	--	--	--	--	--	--	--	--	--
Non-Malignant	*33*	*7*	*0.00*	*0.00-0.00*	--	--	--	--	--	--	--	--	--	--	--	--
Neuronal and Mixed Neuronal Glial Tumors	4,064	813	0.34	0.33-0.35	514	103	0.23	0.21-0.25	35	7	0.14	0.10-0.20	158	32	0.16	0.14-0.19
Malignant	*806*	*161*	*0.06*	*0.06-0.06*	*70*	*14*	*0.03*	*0.03-0.04*	--	--	--	--	*36*	*7*	*0.04*	*0.03-0.05*
Non-Malignant	*3,258*	*652*	*0.28*	*0.27-0.29*	*444*	*89*	*0.19*	*0.17-0.21*	*28*	*6*	*0.11*	*0.07-0.16*	*122*	*24*	*0.13*	*0.10-0.15*
Tumors of the Pineal Region	**622**	**124**	**0.05**	**0.05-0.05**	**111**	**22**	**0.05**	**0.04-0.06**	**--**	**--**	**--**	**--**	**22**	**4**	**0.02**	**0.01-0.04**
Malignant	*331*	*66*	*0.03*	*0.02-0.03*	*79*	*16*	*0.03*	*0.03-0.04*	--	--	--	--	--	--	--	--
Non-Malignant	*291*	*58*	*0.02*	*0.02-0.03*	*32*	*6*	*0.01*	*0.01-0.02*	--	--	--	--	--	--	--	--
Embryonal Tumors	**2,745**	**549**	**0.25**	**0.24-0.26**	**399**	**80**	**0.17**	**0.15-0.18**	**35**	**7**	**0.14**	**0.10-0.19**	**130**	**26**	**0.15**	**0.12-0.17**

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	**30,265**	**6,053**	**2.13**	**2.11-2.16**	**2,241**	**448**	**1.05**	**1.01-1.10**	**227**	**45**	**1.11**	**0.97-1.27**	**1,662**	**332**	**1.66**	**1.58-1.75**
Nerve Sheath Tumors	30,231	6,046	2.13	2.11-2.16	2,238	448	1.05	1.00-1.09	226	45	1.11	0.96-1.27	1,661	332	1.66	1.58-1.75
Malignant	*171*	*34*	*0.01*	*0.01-0.01*	*27*	*5*	*0.01*	*0.01-0.02*	--	--	--	--	--	--	--	--
Non-Malignant	*30,060*	*6,012*	*2.12*	*2.09-2.14*	*2,211*	*442*	*1.04*	*0.99-1.08*	*225*	*45*	*1.10*	*0.96-1.26*	*1,647*	*329*	*1.65*	*1.57-1.73*
Other Tumors of Cranial and Spinal Nerves	34	7	0.00	0.00-0.00	--	--	--	--	--	--	--	--	--	--	--	--
Tumors of Meninges	**132,895**	**26,579**	**8.90**	**8.85-8.95**	**20,560**	**4,112**	**10.44**	**10.29-10.59**	**964**	**193**	**5.70**	**5.32-6.09**	**5,871**	**1,174**	**6.49**	**6.33-6.67**
Meningioma	129,114	25,823	8.61	8.56-8.66	20,081	4,016	10.22	10.08-10.37	939	188	5.59	5.22-5.98	5,709	1,142	6.33	6.16-6.50
Malignant	*1,368*	*274*	*0.09*	*0.09-0.10*	*261*	*52*	*0.13*	*0.12-0.15*	--	--	--	--	*82*	*16*	*0.09*	*0.07-0.11*
Non-Malignant	*127,746*	*25,549*	*8.52*	*8.47-8.57*	*19,820*	*3,964*	*10.09*	*9.95-10.24*	--	--	--	--	*5,627*	*1,125*	*6.24*	*6.07-6.41*
Mesenchymal Tumors	1,216	243	0.09	0.09-0.10	144	29	0.07	0.06-0.08	--	--	--	--	60	12	0.06	0.05-0.08
Primary Melanocytic Lesions	99	20	0.01	0.01-0.01	--	--	--	--	--	--	--	--	--	--	--	--
Other Neoplasms Related to the Meninges	2,466	493	0.19	0.18-0.19	330	66	0.15	0.13-0.17	19	4	0.08	0.05-0.13	100	20	0.10	0.08-0.12
Lymphoma and Hematopoietic Neoplasms	**6,854**	**1,371**	**0.45**	**0.44-0.46**	**653**	**131**	**0.32**	**0.29-0.34**	**51**	**10**	**0.29**	**0.21-0.39**	**417**	**83**	**0.45**	**0.41-0.50**
Lymphoma	6,678	1,336	0.44	0.43-0.45	619	124	0.30	0.28-0.33	48	10	0.28	0.20-0.37	405	81	0.44	0.39-0.48
Other Hematopoietic Neoplasms	176	35	0.01	0.01-0.02	34	7	0.02	0.01-0.02	--	--	--	--	--	--	--	--
Germ Cell Tumors and Cysts	**1,238**	**248**	**0.11**	**0.10-0.11**	**167**	**33**	**0.07**	**0.06-0.08**	**--**	**--**	**--**	**--**	**118**	**24**	**0.13**	**0.11-0.15**
Germ Cell Tumors, Cysts and Heterotopias	1,238	248	0.11	0.10-0.11	167	33	0.07	0.06-0.08	--	--	--	--	118	24	0.13	0.11-0.15
Malignant	*840*	*168*	*0.08*	*0.07-0.08*	*113*	*23*	*0.05*	*0.04-0.06*	--	--	--	--	*100*	*20*	*0.11*	*0.09-0.13*
Non-Malignant	*398*	*80*	*0.03*	*0.03-0.04*	*54*	*11*	*0.02*	*0.02-0.03*	--	--	--	--	*18*	*4*	*0.02*	*0.01-0.03*
Tumors of Sellar Region	**52,691**	**10,538**	**3.97**	**3.93-4.00**	**14,603**	**2,921**	**7.00**	**6.88-7.11**	**629**	**126**	**3.10**	**2.85-3.36**	**2,913**	**583**	**2.96**	**2.85-3.07**
Tumors of the Pituitary	50,437	10,087	3.79	3.76-3.83	13,964	2,793	6.70	6.59-6.82	603	121	2.97	2.73-3.23	2,784	557	2.82	2.72-2.93
Malignant	*102*	*20*	*0.01*	*0.01-0.01*	*28*	*6*	*0.01*	*0.01-0.02*	--	--	--	--	--	--	--	--
Non-Malignant	*50,335*	*10,067*	*3.78*	*3.75-3.82*	*13,936*	*2,787*	*6.69*	*6.57-6.80*	*600*	*120*	*2.96*	*2.72-3.22*	*2,781*	*556*	*2.82*	*2.71-2.93*
Craniopharyngioma	2,254	451	0.18	0.17-0.18	639	128	0.29	0.27-0.32	26	5	0.12	0.08-0.19	129	26	0.14	0.11-0.16
Unclassified Tumors	**16,694**	**3,339**	**1.17**	**1.16-1.19**	**2,151**	**430**	**1.09**	**1.04-1.14**	**158**	**32**	**0.89**	**0.75-1.05**	**576**	**115**	**0.65**	**0.60-0.71**
Hemangioma	4,739	948	0.36	0.35-0.37	562	112	0.27	0.24-0.29	61	12	0.30	0.23-0.39	216	43	0.22	0.19-0.26
Neoplasm Unspecified	11,823	2,365	0.81	0.79-0.82	1,547	309	0.80	0.76-0.84	96	19	0.58	0.46-0.72	349	70	0.41	0.37-0.46
Malignant	*5,697*	*1,139*	*0.37*	*0.36-0.38*	*568*	*114*	*0.31*	*0.28-0.33*	*47*	*9*	*0.29*	*0.21-0.39*	*159*	*32*	*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
Non-Malignant	*6,126*	*1,225*	*0.43*	*0.42-0.45*	*979*	*196*	*0.49*	*0.46-0.53*	*49*	*10*	*0.29*	*0.21-0.39*	*190*	*38*	*0.22*	*0.19-0.25*
All Other	132	26	0.01	0.01-0.01	42	8	0.02	0.01-0.03	--	--	--	--	--	--	--	--
TOTAL[d]	**339,661**	**67,932**	**23.83**	**23.75-23.91**	**48,876**	**9,775**	**23.88**	**23.67-24.10**	**2,670**	**534**	**14.23**	**13.67-14.82**	**14,118**	**2,824**	**15.04**	**14.78-15.29**
Malignant	***107,737***	***21,547***	***7.58***	***7.54-7.63***	***9,432***	***1,886***	***4.44***	***4.34-4.53***	***692***	***138***	***3.54***	***3.26-3.83***	***3,169***	***634***	***3.38***	***3.27-3.51***
Non-Malignant	***231,924***	***46,385***	***16.25***	***16.18-16.32***	***39,444***	***7,889***	***19.45***	***19.25-19.65***	***1,978***	***396***	***10.69***	***10.20-11.21***	***10,949***	***2,190***	***11.65***	***11.43-11.88***

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 = 10,086).
d. Refers to all brain tumors including histologies not presented in this table.
- Counts and rates are not presented when fewer than 20 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 13. Five-Year Total, Annual Average Total[a], and Average Annual Age-Adjusted Incidence Rates[b] with 95% Confidence Intervals for 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, 2013-2017

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	**11,766**	**2,353**	**5.01**	**4.92-5.11**	**10,815**	**2,163**	**5.10**	**5.00-5.20**	**291**	**58**	**2.60**	**2.27-2.97**	**101,233**	**20,247**	**6.85**	**6.81-6.89**
Pilocytic Astrocytoma	812	162	0.24	0.23-0.26	732	146	0.25	0.23-0.27	22	4	0.12	0.07-0.19	4,345	869	0.38	0.37-0.40
Diffuse Astrocytoma	816	163	0.33	0.30-0.35	751	150	0.33	0.31-0.36	17	3	0.12	0.06-0.20	6,606	1,321	0.48	0.47-0.49
Anaplastic Astrocytoma	665	133	0.28	0.26-0.30	611	122	0.28	0.26-0.31	21	4	0.17	0.10-0.27	6,447	1,289	0.45	0.44-0.46
Unique Astrocytoma Variants	189	38	0.07	0.06-0.08	173	35	0.07	0.06-0.08	--	--	--	--	934	187	0.07	0.07-0.08
Malignant	*113*	*23*	*0.04*	*0.03-0.05*	*106*	*21*	*0.04*	*0.04-0.05*	--	--	--	--	*656*	*131*	*0.05*	*0.05-0.05*
Non-Malignant	*76*	*15*	*0.02*	*0.02-0.03*	*67*	*13*	*0.02*	*0.02-0.03*	--	--	--	--	*278*	*56*	*0.02*	*0.02-0.03*
Glioblastoma	4,723	945	2.46	2.39-2.53	4,414	883	2.51	2.44-2.59	118	24	1.41	1.15-1.71	55,322	11,064	3.32	3.29-3.35
Oligodendroglioma	429	86	0.16	0.15-0.18	395	79	0.17	0.15-0.19	--	--	--	--	3,265	653	0.25	0.24-0.26
Anaplastic Oligodendroglioma	235	47	0.10	0.08-0.11	214	43	0.10	0.08-0.11	--	--	--	--	1,624	325	0.12	0.11-0.12
Oligoastrocytic Tumors	170	34	0.07	0.06-0.08	158	32	0.07	0.06-0.08	--	--	--	--	1,401	280	0.11	0.10-0.11
Ependymal Tumors	962	192	0.36	0.34-0.39	868	174	0.36	0.34-0.39	20	4	0.15	0.08-0.24	5,876	1,175	0.44	0.42-0.45
Malignant	*624*	*125*	*0.23*	*0.21-0.25*	*570*	*114*	*0.23*	*0.21-0.25*	--	--	--	--	*3,346*	*669*	*0.25*	*0.24-0.26*
Non-Malignant	*338*	*68*	*0.13*	*0.12-0.15*	*298*	*60*	*0.13*	*0.12-0.15*	--	--	--	--	*2,530*	*506*	*0.18*	*0.18-0.19*
Glioma Malignant, NOS	1,042	208	0.40	0.37-0.42	934	187	0.40	0.37-0.43	38	8	0.29	0.19-0.42	7,047	1,409	0.54	0.53-0.55
Choroid Plexus Tumors	164	33	0.05	0.04-0.06	152	30	0.05	0.05-0.06	--	--	--	--	662	132	0.05	0.05-0.06
Malignant	*26*	*5*	*0.01*	*0.00-0.01*	*24*	*5*	*0.01*	*0.00-0.01*	--	--	--	--	*102*	*20*	*0.01*	*0.01-0.01*
Non-Malignant	*138*	*28*	*0.05*	*0.04-0.05*	*128*	*26*	*0.05*	*0.04-0.06*	--	--	--	--	*560*	*112*	*0.05*	*0.04-0.05*
Other Neuroepithelial Tumors	21	4	0.01	0.00-0.01	17	3	0.01	0.00-0.01	--	--	--	--	86	17	0.01	0.01-0.01
Malignant	--	--	--	--	--	--	--	--	--	--	--	--	*52*	*10*	*0.00*	*0.00-0.01*
Non-Malignant	--	--	--	--	--	--	--	--	--	--	--	--	*34*	*7*	*0.00*	*0.00-0.00*
Neuronal and Mixed Neuronal Glial Tumors	677	135	0.23	0.21-0.24	605	121	0.23	0.21-0.24	16	3	0.08	0.05-0.14	4,250	850	0.34	0.33-0.35
Malignant	*123*	*25*	*0.05*	*0.04-0.06*	*110*	*22*	*0.05*	*0.04-0.06*	--	--	--	--	*823*	*165*	*0.06*	*0.05-0.06*
Non-Malignant	*554*	*111*	*0.18*	*0.16-0.19*	*495*	*99*	*0.18*	*0.16-0.20*	--	--	--	--	*3,427*	*685*	*0.28*	*0.27-0.29*
Tumors of the Pineal Region	**116**	**23**	**0.04**	**0.03-0.05**	**107**	**21**	**0.04**	**0.03-0.05**	**--**	**--**	**--**	**--**	**670**	**134**	**0.05**	**0.05-0.06**
Malignant	*76*	*15*	*0.03*	*0.02-0.03*	*70*	*14*	*0.03*	*0.02-0.03*	--	--	--	--	*370*	*74*	*0.03*	*0.03-0.03*
Non-Malignant	*40*	*8*	*0.02*	*0.01-0.02*	*37*	*7*	*0.02*	*0.01-0.02*	--	--	--	--	*300*	*60*	*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	**745**	**149**	**0.22**	**0.21-0.24**	**684**	**137**	**0.23**	**0.21-0.25**	**--**	**--**	**--**	**--**	**2,698**	**540**	**0.24**	**0.23-0.25**
Tumors of Cranial and Spinal Nerves	**3,193**	**639**	**1.41**	**1.36-1.46**	**2,873**	**575**	**1.40**	**1.35-1.45**	**81**	**16**	**0.72**	**0.56-0.91**	**32,378**	**6,476**	**2.14**	**2.11-2.16**
Nerve Sheath Tumors	3,187	637	1.41	1.36-1.46	2,867	573	1.40	1.34-1.45	81	16	0.72	0.56-0.91	32,344	6,469	2.13	2.11-2.16
Malignant	*43*	*9*	*0.02*	*0.01-0.03*	*37*	*7*	*0.02*	*0.01-0.03*	*--*	*--*	*--*	*--*	*180*	*36*	*0.01*	*0.01-0.01*
Non-Malignant	*3,144*	*629*	*1.39*	*1.34-1.44*	*2,830*	*566*	*1.38*	*1.33-1.43*	*81*	*16*	*0.72*	*0.56-0.91*	*32,164*	*6,433*	*2.12*	*2.10-2.15*
Other Tumors of Cranial and Spinal Nerves	--	--	--	--	--	--	--	--	--	--	--	--	34	7	0.00	0.00-0.00
Tumors of Meninges	**15,869**	**3,174**	**8.44**	**8.30-8.58**	**14,496**	**2,899**	**8.43**	**8.28-8.57**	**457**	**91**	**5.62**	**5.07-6.20**	**147,677**	**29,535**	**9.21**	**9.16-9.26**
Meningioma	15,254	3,051	8.20	8.06-8.34	13,927	2,785	8.18	8.04-8.32	450	90	5.57	5.02-6.15	143,716	28,743	8.93	8.88-8.98
Malignant	*187*	*37*	*0.09*	*0.08-0.11*	*173*	*35*	*0.10*	*0.08-0.11*	*--*	*--*	*--*	*--*	*1,563*	*313*	*0.10*	*0.09-0.10*
Non-Malignant	*15,067*	*3,013*	*8.10*	*7.97-8.24*	*13,754*	*2,751*	*8.08*	*7.94-8.22*	*443*	*89*	*5.48*	*4.94-6.05*	*142,153*	*28,431*	*8.83*	*8.79-8.88*
Mesenchymal Tumors	211	42	0.08	0.07-0.10	198	40	0.09	0.08-0.10	--	--	--	--	1,250	250	0.09	0.09-0.10
Primary Melanocytic Lesions	--	--	--	--	--	--	--	--	--	--	--	--	98	20	0.01	0.01-0.01
Other Neoplasms Related to the Meninges	394	79	0.16	0.14-0.17	362	72	0.16	0.14-0.18	--	--	--	--	2,613	523	0.18	0.18-0.19
Lymphoma and Hematopoietic Neoplasms	**956**	**191**	**0.50**	**0.47-0.53**	**896**	**179**	**0.51**	**0.48-0.55**	**18**	**4**	**0.17**	**0.09-0.27**	**7,192**	**1,438**	**0.44**	**0.43-0.45**
Lymphoma	924	185	0.49	0.45-0.52	868	174	0.50	0.47-0.54	18	4	0.17	0.09-0.27	6,993	1,399	0.43	0.42-0.44
Other Hematopoietic Neoplasms	32	6	0.01	0.01-0.02	28	6	0.01	0.01-0.02	--	--	--	--	199	40	0.01	0.01-0.02
Germ Cell Tumors and Cysts	**347**	**69**	**0.11**	**0.10-0.12**	**314**	**63**	**0.11**	**0.10-0.12**	**--**	**--**	**--**	**--**	**1,237**	**247**	**0.11**	**0.10-0.11**
Germ Cell Tumors, Cysts and Heterotopias	347	69	0.11	0.10-0.12	314	63	0.11	0.10-0.12	--	--	--	--	1,237	247	0.11	0.10-0.11
Malignant	*251*	*50*	*0.07*	*0.07-0.08*	*226*	*45*	*0.08*	*0.07-0.09*	*--*	*--*	*--*	*--*	*843*	*169*	*0.07*	*0.07-0.08*
Non-Malignant	*96*	*19*	*0.03*	*0.03-0.04*	*88*	*18*	*0.03*	*0.03-0.04*	*--*	*--*	*--*	*--*	*394*	*79*	*0.03*	*0.03-0.04*
Tumors of Sellar Region	**11,655**	**2,331**	**4.86**	**4.77-4.95**	**10,443**	**2,089**	**4.82**	**4.72-4.91**	**400**	**80**	**3.54**	**3.17-3.94**	**61,618**	**12,324**	**4.32**	**4.29-4.36**
Tumors of the Pituitary	11,184	2,237	4.68	4.59-4.77	10,011	2,002	4.64	4.54-4.73	386	77	3.45	3.08-3.85	58,960	11,792	4.13	4.09-4.16
Malignant	*25*	*5*	*0.01*	*0.01-0.02*	*21*	*4*	*0.01*	*0.01-0.02*	*--*	*--*	*--*	*--*	*117*	*23*	*0.01*	*0.01-0.01*
Non-Malignant	*11,159*	*2,232*	*4.67*	*4.58-4.76*	*9,990*	*1,998*	*4.63*	*4.53-4.72*	*386*	*77*	*3.45*	*3.08-3.85*	*58,843*	*11,769*	*4.12*	*4.08-4.15*
Craniopharyngioma	471	94	0.18	0.16-0.19	432	86	0.18	0.16-0.20	--	--	--	--	2,658	532	0.20	0.19-0.21
Unclassified Tumors	**2,394**	**479**	**1.15**	**1.10-1.20**	**2,187**	**437**	**1.16**	**1.11-1.22**	**63**	**13**	**0.65**	**0.48-0.86**	**17,658**	**3,532**	**1.16**	**1.15-1.18**
Hemangioma	850	170	0.35	0.33-0.38	782	156	0.36	0.33-0.39	21	4	0.16	0.09-0.26	4,876	975	0.35	0.34-0.36

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
Neoplasm Unspecified	1,524	305	0.79	0.75-0.83	1,389	278	0.79	0.75-0.84	42	8	0.49	0.34-0.69	12,608	2,522	0.81	0.79-0.82
Malignant	*600*	*120*	*0.35*	*0.32-0.38*	*555*	*111*	*0.35*	*0.32-0.38*	--	--	--	--	*5,987*	*1,197*	*0.36*	*0.36-0.37*
Non-Malignant	*924*	*185*	*0.44*	*0.41-0.47*	*834*	*167*	*0.44*	*0.41-0.47*	--	--	--	--	*6,621*	*1,324*	*0.44*	*0.43-0.45*
All Other	20	4	0.01	0.01-0.02	16	3	0.01	0.01-0.02	--	--	--	--	174	35	0.01	0.01-0.01
TOTAL[d]	**46,180**	**9,236**	**21.48**	**21.27-21.69**	**42,024**	**8,405**	**21.53**	**21.31-21.75**	**1,321**	**264**	**13.36**	**12.57-14.18**	**368,993**	**73,799**	**24.23**	**24.15-24.31**
Malignant	***12,782***	***2,556***	***5.70***	***5.60-5.81***	***11,795***	***2,359***	***5.81***	***5.70-5.93***	***308***	***62***	***2.83***	***2.48-3.21***	***110,653***	***22,131***	***7.33***	***7.29-7.37***
Non-Malignant	***33,398***	***6,680***	***15.78***	***15.60-15.96***	***30,229***	***6,046***	***15.72***	***15.53-15.90***	***1,013***	***203***	***10.54***	***9.83-11.28***	***258,340***	***51,668***	***16.90***	***16.84-16.97***

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. 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 20 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 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, 2013-2017

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	**15,802**	**3,160**	**3.88**	**3.82-3.94**	**8,556**	**1,711**	**4.11**	**4.02-4.20**	**7,246**	**1,449**	**3.63**	**3.55-3.72**
Pilocytic Astrocytoma	3,744	749	0.92	0.89-0.95	1,959	392	0.94	0.90-0.98	1,785	357	0.90	0.86-0.94
Diffuse Astrocytoma	954	191	0.23	0.22-0.25	513	103	0.25	0.23-0.27	441	88	0.22	0.20-0.24
Anaplastic Astrocytoma	394	79	0.10	0.09-0.11	217	43	0.10	0.09-0.12	177	35	0.09	0.08-0.10
Unique Astrocytoma Variants	490	98	0.12	0.11-0.13	270	54	0.13	0.11-0.15	220	44	0.11	0.10-0.13
Malignant	*237*	*47*	*0.06*	*0.05-0.07*	*129*	*26*	*0.06*	*0.05-0.07*	*108*	*22*	*0.05*	*0.04-0.07*
Non-Malignant	*253*	*51*	*0.06*	*0.05-0.07*	*141*	*28*	*0.07*	*0.06-0.08*	*112*	*22*	*0.06*	*0.05-0.07*
Glioblastoma	717	143	0.18	0.16-0.19	397	79	0.19	0.17-0.21	320	64	0.16	0.14-0.18
Oligodendroglioma	175	35	0.04	0.04-0.05	87	17	0.04	0.03-0.05	88	18	0.04	0.04-0.05
Anaplastic Oligodendroglioma	27	5	0.01	0.00-0.01	--	--	--	--	--	--	--	--
Oligoastrocytic Tumors	64	13	0.02	0.01-0.02	32	6	0.02	0.01-0.02	32	6	0.02	0.01-0.02
Ependymal Tumors	1,191	238	0.29	0.28-0.31	668	134	0.32	0.30-0.35	523	105	0.26	0.24-0.29
Malignant	*997*	*199*	*0.24*	*0.23-0.26*	*558*	*112*	*0.27*	*0.25-0.29*	*439*	*88*	*0.22*	*0.20-0.24*
Non-Malignant	*194*	*39*	*0.05*	*0.04-0.05*	*110*	*22*	*0.05*	*0.04-0.06*	*84*	*17*	*0.04*	*0.03-0.05*
Glioma Malignant, NOS	2,989	598	0.73	0.71-0.76	1,506	301	0.72	0.69-0.76	1,483	297	0.74	0.71-0.78
Choroid Plexus Tumors	409	82	0.10	0.09-0.11	231	46	0.11	0.10-0.13	178	36	0.09	0.08-0.10
Malignant	*104*	*21*	*0.03*	*0.02-0.03*	*60*	*12*	*0.03*	*0.02-0.04*	*44*	*9*	*0.02*	*0.02-0.03*
Non-Malignant	*305*	*61*	*0.07*	*0.07-0.08*	*171*	*34*	*0.08*	*0.07-0.10*	*134*	*27*	*0.07*	*0.06-0.08*
Other Neuroepithelial Tumors	32	6	0.01	0.01-0.01	--	--	--	--	--	--	--	--
Malignant	--	--	--	--	--	--	--	--	--	--	--	--
Non-Malignant	--	--	--	--	--	--	--	--	--	--	--	--
Neuronal and Mixed Neuronal Glial Tumors	1,927	385	0.47	0.45-0.49	1,063	213	0.51	0.48-0.54	864	173	0.43	0.40-0.46
Malignant	*111*	*22*	*0.03*	*0.02-0.03*	*64*	*13*	*0.03*	*0.02-0.04*	*47*	*9*	*0.02*	*0.02-0.03*
Non-Malignant	*1,816*	*363*	*0.44*	*0.42-0.47*	*999*	*200*	*0.48*	*0.45-0.51*	*817*	*163*	*0.41*	*0.38-0.44*
Tumors of the Pineal Region	211	42	0.05	0.04-0.06	106	21	0.05	0.04-0.06	105	21	0.05	0.04-0.06
Malignant	*174*	*35*	*0.04*	*0.04-0.05*	--	--	--	--	--	--	--	--
Non-Malignant	*37*	*7*	*0.01*	*0.01-0.01*	--	--	--	--	--	--	--	--
Embryonal Tumors	2,478	496	0.61	0.58-0.63	1,481	296	0.71	0.68-0.75	997	199	0.50	0.47-0.53
Medulloblastoma	*1,637*	*327*	*0.40*	*0.38-0.42*	*1,055*	*211*	*0.51*	*0.48-0.54*	*582*	*116*	*0.29*	*0.27-0.32*

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
Primitive neuroectodermal tumors	*241*	*48*	*0.06*	*0.05-0.07*	*121*	*24*	*0.06*	*0.05-0.07*	*120*	*24*	*0.06*	*0.05-0.07*
Atypical teratoid rhabdoid tumor	*380*	*76*	*0.09*	*0.08-0.10*	*197*	*39*	*0.09*	*0.08-0.11*	*183*	*37*	*0.09*	*0.08-0.11*
Other embryonal histologies	*220*	*44*	*0.05*	*0.05-0.06*	*108*	*22*	*0.05*	*0.04-0.06*	*112*	*22*	*0.06*	*0.05-0.07*
Tumors of Cranial and Spinal Nerves	**1,291**	**258**	**0.32**	**0.30-0.33**	**687**	**137**	**0.33**	**0.30-0.35**	**604**	**121**	**0.30**	**0.28-0.33**
Nerve SheathTumors	1,288	258	0.31	0.30-0.33	684	137	0.33	0.30-0.35	604	121	0.30	0.28-0.33
Malignant	--	--	--	--	--	--	--	--	--	--	--	--
Non-Malignant	--	--	--	--	--	--	--	--	--	--	--	--
OtherTumors of Cranial and Spinal Nerves	--	--	--	--	--	--	--	--	--	--	--	--
Tumors of Meninges	**1,133**	**227**	**0.28**	**0.26-0.29**	**539**	**108**	**0.26**	**0.24-0.28**	**594**	**119**	**0.30**	**0.27-0.32**
Meningioma	649	130	0.16	0.15-0.17	292	58	0.14	0.12-0.16	357	71	0.18	0.16-0.20
Malignant	*34*	*7*	*0.01*	*0.01-0.01*	--	--	--	--	--	--	--	--
Non-Malignant	*615*	*123*	*0.15*	*0.14-0.16*	--	--	--	--	--	--	--	--
MesenchymalTumors	267	53	0.07	0.06-0.07	143	29	0.07	0.06-0.08	124	25	0.06	0.05-0.07
Primary Melanocytic Lesions	--	--	--	--	--	--	--	--	--	--	--	--
Other Neoplasms Related to the Meninges	205	41	0.05	0.04-0.06	97	19	0.05	0.04-0.06	108	22	0.05	0.04-0.06
Lymphoma and Hematopoietic Neoplasms	**122**	**24**	**0.03**	**0.02-0.04**	**76**	**15**	**0.04**	**0.03-0.05**	**46**	**9**	**0.02**	**0.02-0.03**
Lymphoma	59	12	0.01	0.01-0.02	40	8	0.02	0.01-0.03	19	4	0.01	0.01-0.01
Other Hematopoietic Neoplasms	63	13	0.02	0.01-0.02	36	7	0.02	0.01-0.02	27	5	0.01	0.01-0.02
Germ Cell Tumors and Cysts	**993**	**199**	**0.24**	**0.23-0.26**	**671**	**134**	**0.32**	**0.30-0.35**	**322**	**64**	**0.16**	**0.14-0.18**
Germ CellTumors, Cysts and Heterotopias	993	199	0.24	0.23-0.26	671	134	0.32	0.30-0.35	322	64	0.16	0.14-0.18
Malignant	*775*	*155*	*0.19*	*0.18-0.20*	*550*	*110*	*0.26*	*0.24-0.29*	*225*	*45*	*0.11*	*0.10-0.13*
Non-Malignant	*218*	*44*	*0.05*	*0.05-0.06*	*121*	*24*	*0.06*	*0.05-0.07*	*97*	*19*	*0.05*	*0.04-0.06*
Tumors of Sellar Region	**4,254**	**851**	**1.03**	**1.00-1.07**	**1,374**	**275**	**0.66**	**0.62-0.69**	**2,880**	**576**	**1.43**	**1.38-1.48**
Tumors of the Pituitary	3,393	679	0.82	0.79-0.85	915	183	0.44	0.41-0.46	2,478	496	1.23	1.18-1.28
Malignant	--	--	--	--	--	--	--	--	--	--	--	--
Non-Malignant	--	--	--	--	--	--	--	--	--	--	--	--
Craniopharyngioma	861	172	0.21	0.20-0.23	459	92	0.22	0.20-0.24	402	80	0.20	0.18-0.22

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
Unclassified Tumors	**1,510**	**302**	**0.37**	**0.35-0.39**	**757**	**151**	**0.36**	**0.34-0.39**	**753**	**151**	**0.38**	**0.35-0.40**
Hemangioma	598	120	0.15	0.13-0.16	302	60	0.14	0.13-0.16	296	59	0.15	0.13-0.17
Neoplasm Unspecified	872	174	0.21	0.20-0.23	436	87	0.21	0.19-0.23	436	87	0.22	0.20-0.24
Malignant	*218*	*44*	*0.05*	*0.05-0.06*	*113*	*23*	*0.05*	*0.04-0.07*	*105*	*21*	*0.05*	*0.04-0.06*
Non-Malignant	*654*	*131*	*0.16*	*0.15-0.17*	*323*	*65*	*0.16*	*0.14-0.17*	*331*	*66*	*0.17*	*0.15-0.18*
All Other	40	8	0.01	0.01-0.01	19	4	0.01	0.01-0.01	21	4	0.01	0.01-0.02
TOTAL[c]	**25,105**	**5,021**	**6.14**	**6.07-6.22**	**12,660**	**2,532**	**6.07**	**5.96-6.18**	**12,445**	**2,489**	**6.22**	**6.11-6.33**
Malignant	***14,463***	***2,893***	***3.55***	***3.49-3.61***	***7,943***	***1,589***	***3.81***	***3.73-3.90***	***6,520***	***1,304***	***3.27***	***3.19-3.35***
Non-Malignant	***10,642***	***2,128***	***2.60***	***2.55-2.65***	***4,717***	***943***	***2.26***	***2.19-2.32***	***5,925***	***1,185***	***2.95***	***2.88-3.03***

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 20 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 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, 2013-2017

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	**12,466**	**2,493**	**4.06**	**3.99-4.13**	**2,030**	**406**	**2.97**	**2.85-3.11**	**135**	**27**	**1.78**	**1.50-2.11**	**512**	**102**	**2.05**	**1.88-2.24**
Pilocytic Astrocytoma	3,014	603	0.98	0.95-1.02	457	91	0.67	0.61-0.73	28	6	0.37	0.25-0.53	89	18	0.36	0.29-0.44
Diffuse Astrocytoma	754	151	0.25	0.23-0.26	113	23	0.17	0.14-0.20	--	--	--	--	33	7	0.13	0.09-0.19
Anaplastic Astrocytoma	311	62	0.10	0.09-0.11	50	10	0.07	0.05-0.10	--	--	--	--	19	4	0.08	0.05-0.12
Unique Astrocytoma Variants	373	75	0.12	0.11-0.13	73	15	0.11	0.08-0.14	--	--	--	--	17	3	0.07	0.04-0.11
Malignant	*195*	*39*	*0.06*	*0.05-0.07*	*24*	*5*	*0.04*	*0.02-0.05*	--	--	--	--	--	--	--	--
Non-Malignant	*178*	*36*	*0.06*	*0.05-0.07*	*49*	*10*	*0.07*	*0.05-0.10*	--	--	--	--	--	--	--	--
Glioblastoma	550	110	0.18	0.16-0.19	94	19	0.14	0.11-0.17	--	--	--	--	35	7	0.14	0.10-0.20
Oligodendroglioma	137	27	0.04	0.04-0.05	23	5	0.03	0.02-0.05	--	--	--	--	--	--	--	--
Anaplastic Oligodendroglioma	18	4	0.01	0.00-0.01	--	--	--	--	--	--	--	--	--	--	--	--
Oligoastrocytic Tumors	54	11	0.02	0.01-0.02	--	--	--	--	--	--	--	--	--	--	--	--
Ependymal Tumors	960	192	0.31	0.29-0.33	144	29	0.21	0.18-0.25	--	--	--	--	43	9	0.17	0.12-0.23
Malignant	*791*	*158*	*0.26*	*0.24-0.28*	--	--	--	--	--	--	--	--	--	--	--	--
Non-Malignant	*169*	*34*	*0.05*	*0.05-0.06*	--	--	--	--	--	--	--	--	--	--	--	--
Glioma Malignant, NOS	2,331	466	0.76	0.73-0.79	417	83	0.61	0.55-0.67	24	5	0.31	0.20-0.47	82	16	0.33	0.26-0.41
Choroid Plexus Tumors	327	65	0.11	0.10-0.12	50	10	0.07	0.05-0.10	--	--	--	--	--	--	--	--
Malignant	*78*	*16*	*0.03*	*0.02-0.03*	*16*	*3*	*0.02*	*0.01-0.04*	--	--	--	--	--	--	--	--
Non-Malignant	*249*	*50*	*0.08*	*0.07-0.09*	*34*	*7*	*0.05*	*0.03-0.07*	--	--	--	--	--	--	--	--
Other Neuroepithelial Tumors	24	5	0.01	0.01-0.01	--	--	--	--	--	--	--	--	--	--	--	--
Malignant	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Non-Malignant	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Neuronal and Mixed Neuronal Glial Tumors	1,537	307	0.50	0.47-0.52	247	49	0.36	0.32-0.41	16	3	0.21	0.12-0.35	59	12	0.24	0.18-0.31
Malignant	*86*	*17*	*0.03*	*0.02-0.03*	*18*	*4*	*0.03*	*0.02-0.04*	--	--	--	--	--	--	--	--
Non-Malignant	*1,451*	*290*	*0.47*	*0.45-0.50*	*229*	*46*	*0.34*	*0.29-0.38*	--	--	--	--	--	--	--	--
Tumors of the Pineal Region	140	28	0.05	0.04-0.05	49	10	0.07	0.05-0.10	--	--	--	--	--	--	--	--

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
Malignant	*109*	*22*	*0.04*	*0.03-0.04*	--	--	--	--	--	--	--	--	--	--	--	--
Non-Malignant	*31*	*6*	*0.01*	*0.01-0.01*	--	--	--	--	--	--	--	--	--	--	--	--
Embryonal Tumors	1,936	387	0.63	0.61-0.66	298	60	0.43	0.39-0.49	26	5	0.34	0.22-0.49	111	22	0.44	0.36-0.53
Medulloblastoma	*1,300*	*260*	*0.43*	*0.40-0.45*	*173*	*35*	*0.25*	*0.22-0.29*	*18*	*4*	*0.24*	*0.14-0.37*	*77*	*15*	*0.31*	*0.24-0.38*
Primitive neuroectodermal tumors	*183*	*37*	*0.06*	*0.05-0.07*	*39*	*8*	*0.06*	*0.04-0.08*	--	--	--	--	--	--	--	--
Atypical teratoid rhabdoid tumor	*280*	*56*	*0.09*	*0.08-0.10*	*59*	*12*	*0.08*	*0.06-0.11*	--	--	--	--	*19*	*4*	*0.08*	*0.05-0.12*
Other embryonal histologies	*173*	*35*	*0.06*	*0.05-0.07*	*27*	*5*	*0.04*	*0.03-0.06*	--	--	--	--	--	--	--	--
Tumors of Cranial and Spinal Nerves	**1,002**	**200**	**0.32**	**0.30-0.35**	**162**	**32**	**0.24**	**0.20-0.28**	**--**	**--**	**--**	**--**	**44**	**9**	**0.18**	**0.13-0.24**
Nerve Sheath Tumors	999	200	0.32	0.30-0.34	162	32	0.24	0.20-0.28	--	--	--	--	44	9	0.18	0.13-0.24
Malignant	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Non-Malignant	--	--	--	--	--	--	--	--	--	--	--	--	*44*	*9*	*0.18*	*0.13-0.24*
Other Tumors of Cranial and Spinal Nerves	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Tumors of Meninges	**894**	**179**	**0.29**	**0.27-0.31**	**150**	**30**	**0.22**	**0.19-0.26**	**--**	**--**	**--**	**--**	**33**	**7**	**0.13**	**0.09-0.19**
Meningioma	506	101	0.16	0.15-0.18	94	19	0.14	0.11-0.17	--	--	--	--	19	4	0.08	0.05-0.12
Malignant	*28*	*6*	*0.01*	*0.01-0.01*	--	--	--	--	--	--	--	--	--	--	--	--
Non-Malignant	*478*	*96*	*0.15*	*0.14-0.17*	--	--	--	--	--	--	--	--	*19*	*4*	*0.08*	*0.05-0.12*
Mesenchymal Tumors	209	42	0.07	0.06-0.08	32	6	0.05	0.03-0.07	--	--	--	--	--	--	--	--
Primary Melanocytic Lesions	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Other Neoplasms Related to the Meninges	168	34	0.05	0.05-0.06	24	5	0.04	0.02-0.05	--	--	--	--	--	--	--	--
Lymphoma and Hematopoietic Neoplasms	**89**	**18**	**0.03**	**0.02-0.04**	**--**	**--**	**--**	**--**	**--**	**--**	**--**	**--**	**--**	**--**	**--**	**--**
Lymphoma	42	8	0.01	0.01-0.02	--	--	--	--	--	--	--	--	--	--	--	--
Other Hematopoietic Neoplasms	47	9	0.02	0.01-0.02	--	--	--	--	--	--	--	--	--	--	--	--

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
Germ Cell Tumors and Cysts	**756**	**151**	**0.25**	**0.23-0.26**	**106**	**21**	**0.16**	**0.13-0.19**	**--**	**--**	**--**	**--**	**87**	**17**	**0.35**	**0.28-0.43**
Germ Cell Tumors, Cysts and Heterotopias	756	151	0.25	0.23-0.26	106	21	0.16	0.13-0.19	--	--	--	--	87	17	0.35	0.28-0.43
Malignant	*588*	*118*	*0.19*	*0.18-0.21*	*79*	*16*	*0.12*	*0.09-0.15*	--	--	--	--	--	--	--	--
Non-Malignant	*168*	*34*	*0.05*	*0.05-0.06*	*27*	*5*	*0.04*	*0.03-0.06*	--	--	--	--	--	--	--	--
Tumors of Sellar Region	**3,170**	**634**	**1.02**	**0.98-1.05**	**657**	**131**	**0.96**	**0.89-1.04**	**59**	**12**	**0.80**	**0.61-1.03**	**145**	**29**	**0.59**	**0.49-0.69**
Tumors of the Pituitary	2,536	507	0.81	0.78-0.84	500	100	0.73	0.67-0.80	53	11	0.72	0.54-0.94	106	21	0.43	0.35-0.52
Malignant	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Non-Malignant	--	--	--	--	*500*	*100*	*0.73*	*0.67-0.80*	--	--	--	--	*106*	*21*	*0.43*	*0.35-0.52*
Craniopharyngioma	634	127	0.21	0.19-0.22	157	31	0.23	0.20-0.27	--	--	--	--	39	8	0.16	0.11-0.21
Unclassified Tumors	**1,193**	**239**	**0.39**	**0.37-0.41**	**178**	**36**	**0.26**	**0.22-0.30**	**17**	**3**	**0.23**	**0.13-0.36**	**34**	**7**	**0.14**	**0.09-0.19**
Hemangioma	496	99	0.16	0.15-0.18	51	10	0.07	0.06-0.10	--	--	--	--	18	4	0.07	0.04-0.11
Neoplasm Unspecified	671	134	0.22	0.20-0.24	115	23	0.17	0.14-0.20	--	--	--	--	16	3	0.06	0.04-0.10
Malignant	*159*	*32*	*0.05*	*0.04-0.06*	*37*	*7*	*0.05*	*0.04-0.07*	--	--	--	--	--	--	--	--
Non-Malignant	*512*	*102*	*0.17*	*0.15-0.18*	*78*	*16*	*0.11*	*0.09-0.14*	--	--	--	--	--	--	--	--
All Other	26	5	0.01	0.01-0.01	--	--	--	--	--	--	--	--	--	--	--	--
TOTAL[d]	**19,570**	**3,914**	**6.36**	**6.27-6.45**	**3,294**	**659**	**4.83**	**4.66-4.99**	**242**	**48**	**3.22**	**2.83-3.65**	**868**	**174**	**3.48**	**3.26-3.72**
Malignant	***11,343***	***2,269***	***3.70***	***3.63-3.77***	***1,857***	***371***	***2.72***	***2.60-2.85***	***131***	***26***	***1.73***	***1.45-2.05***	***529***	***106***	***2.12***	***1.94-2.31***
Non-Malignant	***8,227***	***1,645***	***2.66***	***2.60-2.72***	***1,437***	***287***	***2.11***	***2.00-2.22***	***111***	***22***	***1.49***	***1.23-1.80***	***339***	***68***	***1.36***	***1.22-1.52***

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. Refers to all brain tumors including histologies not presented in this table.
- Counts and rates are not presented when fewer than 20 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 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, 2013-2017

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	**2,977**	**595**	**2.96**	**2.85-3.07**	**2,704**	**541**	**3.04**	**2.93-3.16**	**82**	**16**	**1.34**	**1.06-1.66**	**12,805**	**2,561**	**4.17**	**4.09-4.24**
Pilocytic Astrocytoma	651	130	0.64	0.60-0.70	591	118	0.66	0.61-0.72	--	--	--	--	3,084	617	1.01	0.97-1.04
Diffuse Astrocytoma	147	29	0.15	0.12-0.17	134	27	0.15	0.13-0.18	--	--	--	--	807	161	0.26	0.24-0.28
Anaplastic Astrocytoma	85	17	0.09	0.07-0.11	76	15	0.09	0.07-0.11	--	--	--	--	309	62	0.10	0.09-0.11
Unique Astrocytoma Variants	108	22	0.11	0.09-0.13	97	19	0.11	0.09-0.13	--	--	--	--	382	76	0.12	0.11-0.14
Malignant	*48*	*10*	*0.05*	*0.04-0.07*	*45*	*9*	*0.05*	*0.04-0.07*	--	--	--	--	*189*	*38*	*0.06*	*0.05-0.07*
Non-Malignant	*60*	*12*	*0.06*	*0.05-0.08*	*52*	*10*	*0.06*	*0.04-0.08*	--	--	--	--	*193*	*39*	*0.06*	*0.05-0.07*
Glioblastoma	152	30	0.15	0.13-0.18	143	29	0.16	0.14-0.19	--	--	--	--	565	113	0.18	0.17-0.20
Oligodendroglioma	21	4	0.02	0.01-0.03	20	4	0.02	0.01-0.04	--	--	--	--	154	31	0.05	0.04-0.06
Anaplastic Oligodendroglioma	--	--	--	--	--	--	--	--	--	--	--	--	20	4	0.01	0.00-0.01
Oligoastrocytic Tumors	--	--	--	--	--	--	--	--	--	--	--	--	54	11	0.02	0.01-0.02
Ependymal Tumors	255	51	0.25	0.22-0.29	236	47	0.27	0.23-0.30	--	--	--	--	936	187	0.30	0.29-0.32
Malignant	*220*	*44*	*0.22*	*0.19-0.25*	*205*	*41*	*0.23*	*0.20-0.26*	--	--	--	--	*777*	*155*	*0.25*	*0.24-0.27*
Non-Malignant	*35*	*7*	*0.04*	*0.03-0.05*	*31*	*6*	*0.04*	*0.02-0.05*	--	--	--	--	*159*	*32*	*0.05*	*0.04-0.06*
Glioma Malignant, NOS	515	103	0.51	0.47-0.56	456	91	0.51	0.47-0.56	21	4	0.33	0.20-0.51	2,470	494	0.81	0.78-0.84
Choroid Plexus Tumors	101	20	0.10	0.08-0.12	93	19	0.10	0.08-0.13	--	--	--	--	307	61	0.10	0.09-0.11
Malignant	*23*	*5*	*0.02*	*0.01-0.03*	*21*	*4*	*0.02*	*0.01-0.04*	--	--	--	--	*81*	*16*	*0.03*	*0.02-0.03*
Non-Malignant	*78*	*16*	*0.08*	*0.06-0.10*	*72*	*14*	*0.08*	*0.06-0.10*	--	--	--	--	*226*	*45*	*0.07*	*0.06-0.08*
Other Neuroepithelial Tumors	--	--	--	--	--	--	--	--	--	--	--	--	23	5	0.01	0.00-0.01
Malignant	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Non-Malignant	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Neuronal and Mixed Neuronal Glial Tumors	327	65	0.33	0.30-0.37	294	59	0.34	0.30-0.38	--	--	--	--	1,596	319	0.51	0.49-0.54
Malignant	*24*	*5*	*0.02*	*0.02-0.04*	*22*	*4*	*0.03*	*0.02-0.04*	--	--	--	--	*87*	*17*	*0.03*	*0.02-0.03*
Non-Malignant	*303*	*61*	*0.31*	*0.27-0.34*	*272*	*54*	*0.31*	*0.28-0.35*	--	--	--	--	*1,509*	*302*	*0.49*	*0.46-0.51*
Tumors of the Pineal Region	44	9	0.04	0.03-0.06	38	8	0.04	0.03-0.06	--	--	--	--	167	33	0.05	0.05-0.06
Malignant	--	--	--	--	--	--	--	--	--	--	--	--	*139*	*28*	*0.05*	*0.04-0.05*

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
Non-Malignant	--	--	--	--	--	--	--	--	--	--	--	--	*28*	*6*	*0.01*	*0.01-0.01*
Embryonal Tumors	545	109	0.53	0.49-0.58	503	101	0.56	0.51-0.61	--	--	--	--	1,931	386	0.63	0.61-0.66
Medulloblastoma	*350*	*70*	*0.35*	*0.31-0.38*	*326*	*65*	*0.36*	*0.33-0.41*	--	--	--	--	*1,286*	*257*	*0.42*	*0.40-0.45*
Primitive neuroectodermal tumors	*58*	*12*	*0.06*	*0.04-0.07*	*53*	*11*	*0.06*	*0.04-0.08*	--	--	--	--	*183*	*37*	*0.06*	*0.05-0.07*
Atypical teratoid rhabdoid tumor	*85*	*17*	*0.08*	*0.06-0.10*	*78*	*16*	*0.08*	*0.07-0.11*	--	--	--	--	*295*	*59*	*0.10*	*0.09-0.11*
Other embryonal histologies	*52*	*10*	*0.05*	*0.04-0.07*	*46*	*9*	*0.05*	*0.04-0.07*	--	--	--	--	*167*	*33*	*0.05*	*0.05-0.06*
Tumors of Cranial and Spinal Nerves	**243**	**49**	**0.25**	**0.22-0.28**	**213**	**43**	**0.24**	**0.21-0.28**	**--**	**--**	**--**	**--**	**1,046**	**209**	**0.34**	**0.32-0.36**
Nerve Sheath Tumors	242	48	0.24	0.21-0.28	212	42	0.24	0.21-0.28	--	--	--	--	1,044	209	0.34	0.32-0.36
Malignant	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Non-Malignant	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	-
Other Tumors of Cranial and Spinal Nerves	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Tumors of Meninges	**244**	**49**	**0.25**	**0.22-0.28**	**221**	**44**	**0.26**	**0.22-0.29**	**--**	**--**	**--**	**--**	**887**	**177**	**0.28**	**0.26-0.30**
Meningioma	125	25	0.13	0.11-0.15	112	22	0.13	0.11-0.16	--	--	--	--	523	105	0.17	0.15-0.18
Malignant	--	--	--	--	--	--	--	--	--	--	--	--	*26*	*5*	*0.01*	*0.01-0.01*
Non-Malignant	--	--	--	--	--	--	--	--	--	--	--	--	*497*	*99*	*0.16*	*0.14-0.17*
Mesenchymal Tumors	66	13	0.07	0.05-0.08	60	12	0.07	0.05-0.09	--	--	--	--	200	40	0.07	0.06-0.07
Primary Melanocytic Lesions	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Other Neoplasms Related to the Meninges	50	10	0.05	0.04-0.07	47	9	0.06	0.04-0.07	--	--	--	--	155	31	0.05	0.04-0.06
Lymphoma and Hematopoietic Neoplasms	**22**	**4**	**0.02**	**0.01-0.03**	**19**	**4**	**0.02**	**0.01-0.03**	**--**	**--**	**--**	**--**	**100**	**20**	**0.03**	**0.03-0.04**
Lymphoma	--	--	--	--	--	--	--	--	--	--	--	--	46	9	0.01	0.01-0.02
Other Hematopoietic Neoplasms	--	--	--	--	--	--	--	--	--	--	--	--	54	11	0.02	0.01-0.02
Germ Cell Tumors and Cysts	**246**	**49**	**0.25**	**0.22-0.28**	**224**	**45**	**0.26**	**0.22-0.29**	**--**	**--**	**--**	**--**	**746**	**149**	**0.24**	**0.22-0.26**
Germ Cell Tumors, Cysts and Heterotopias	246	49	0.25	0.22-0.28	224	45	0.26	0.22-0.29	--	--	--	--	746	149	0.24	0.22-0.26

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
Malignant	*195*	*39*	*0.20*	*0.17-0.23*	*177*	*35*	*0.21*	*0.18-0.24*	--	--	--	--	*579*	*116*	*0.19*	*0.17-0.20*
Non-Malignant	*51*	*10*	*0.05*	*0.04-0.07*	*47*	*9*	*0.05*	*0.04-0.07*	--	--	--	--	*167*	*33*	*0.05*	*0.05-0.06*
Tumors of Sellar Region	**1,139**	**228**	**1.19**	**1.12-1.26**	**1,024**	**205**	**1.20**	**1.13-1.28**	**34**	**7**	**0.60**	**0.42-0.84**	**3,108**	**622**	**0.99**	**0.95-1.02**
Tumors of the Pituitary	951	190	1.00	0.94-1.07	847	169	1.00	0.94-1.07	--	--	--	--	2,435	487	0.77	0.74-0.80
Malignant	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Non-Malignant	--	--	--	--	--	--	--	--	--	--	--	-	--	--	--	--
Craniopharyngioma	188	38	0.19	0.16-0.22	177	35	0.20	0.17-0.23	--	--	--	--	673	135	0.22	0.20-0.24
Unclassified Tumors	**335**	**67**	**0.34**	**0.30-0.38**	**291**	**58**	**0.33**	**0.30-0.37**	**--**	**--**	**--**	**--**	**1,174**	**235**	**0.38**	**0.36-0.40**
Hemangioma	135	27	0.14	0.11-0.16	124	25	0.14	0.12-0.17	--	--	--	--	463	93	0.15	0.14-0.16
Neoplasm Unspecified	194	39	0.20	0.17-0.23	161	32	0.18	0.16-0.22	--	--	--	--	677	135	0.22	0.20-0.24
Malignant	*50*	*10*	*0.05*	*0.04-0.07*	*42*	*8*	*0.05*	*0.03-0.06*	--	--	--	--	*168*	*34*	*0.05*	*0.05-0.06*
Non-Malignant	*144*	*29*	*0.15*	*0.12-0.17*	*119*	*24*	*0.14*	*0.11-0.16*	--	--	--	--	*509*	*102*	*0.16*	*0.15-0.18*
All Other	--	--	--	--	--	--	--	--	--	--	--	--	34	7	0.01	0.01-0.02
TOTAL[d]	**5,206**	**1,041**	**5.26**	**5.11-5.40**	**4,696**	**939**	**5.36**	**5.21-5.52**	**148**	**30**	**2.47**	**2.09-2.90**	**19,866**	**3,973**	**6.42**	**6.33-6.51**
Malignant	***2,797***	***559***	***2.78***	***2.68-2.88***	***2,544***	***509***	***2.86***	***2.75-2.98***	***76***	***15***	***1.23***	***0.97-1.54***	***11,650***	***2,330***	***3.79***	***3.72-3.86***
Non-Malignant	***2,409***	***482***	***2.48***	***2.38-2.58***	***2,152***	***430***	***2.50***	***2.39-2.61***	***72***	***14***	***1.24***	***0.97-1.56***	***8,216***	***1,643***	***2.63***	***2.57-2.69***

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 20 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 17. Estimated Number of Cases[a,b] of Brain and Other Central Nervous System Tumors Overall and by Behavior by State, 2020, 2021

State	2020 Estimated Cases			2021 Estimated Cases		
	All	Malignant	Non-Malignant	All	Malignant	Non-Malignant
Alabama	1,090	390	700	1,110	390	720
Alaska	190	60	130	200	60	130
Arizona	1,510	490	1,020	1,500	490	1,010
Arkansas	810	280	530	830	280	540
California	8,720	2,870	5,850	8,620	2,900	5,720
Colorado	1,750	450	1,300	1,800	460	1,340
Connecticut	1,010	310	700	1,030	310	720
Delaware	190	90	110	190	90	100
District of Columbia	170	--	--	170	--	--
Florida	6,670	1,790	4,890	6,800	1,800	4,990
Georgia	3,410	730	2,690	3,570	730	2,840
Hawaii	320	80	240	320	80	240
Idaho	480	150	330	500	150	340
Illinois	3,380	1,020	2,360	3,360	1,030	2,330
Indiana	1,050	550	500	970	550	420
Iowa	1,020	280	740	1,050	280	760
Kansas	800	230	570	820	230	590
Kentucky	1,390	450	940	1,390	460	930
Louisiana	1,540	350	1,190	1,600	350	1,250
Maine	310	140	170	310	140	170
Maryland	1,750	460	1,290	1,820	460	1,350
Massachusetts	1,660	580	1,080	1,690	590	1,110
Michigan	2,410	800	1,610	2,410	800	1,610
Minnesota	1,620	510	1,110	1,710	520	1,190
Mississippi	800	230	570	820	230	590
Missouri	1,740	530	1,220	1,770	530	1,230
Montana	330	100	230	340	100	240
Nebraska	480	170	310	490	170	320
Nevada	770	260	510	810	270	540
New Hampshire	400	140	260	410	140	260
New Jersey	2,290	760	1,520	2,220	770	1,450
New Mexico	480	150	330	490	150	340
NewYork	6,870	1,690	5,180	7,030	1,710	5,330
North Carolina	3,000	860	2,140	3,060	870	2,190
North Dakota	200	60	140	200	60	150
Ohio	2,510	1,040	1,470	2,460	1,050	1,410
Oklahoma	710	310	410	690	310	380
Oregon	1,010	390	620	1,030	390	630
Pennsylvania	4,150	1,230	2,920	4,190	1,240	2,950
Rhode Island	220	80	130	220	80	130
South Carolina	1,090	440	660	1,050	450	600
South Dakota	240	70	170	250	70	180
Tennessee	1,820	510	1,310	1,820	510	1,320
Texas	7,310	2,030	5,270	7,430	2,070	5,370
Utah	1,460	230	1,230	1,580	240	1,340

Table 17. Continued

State	2020 Estimated Cases			2021 Estimated Cases		
	All	Malignant	Non-Malignant	All	Malignant	Non-Malignant
Vermont	190	60	130	190	60	130
Virginia	2,300	690	1,610	2,430	700	1,730
Washington	2,980	670	2,300	3,090	690	2,410
West Virginia	520	130	390	520	120	400
Wisconsin	1,780	440	1,340	1,790	440	1,360
Wyoming	160	50	110	170	50	120

a. Source: Estimation based on CBTRUS NPCR and SEER 2000-2017 data for malignant tumors, and NPCR and SEER 2006-2017 data for non-malignant tumors.
b. Rounded to the nearest 10. Numbers may not add up due to rounding.
- 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 Major Histology Grouping[c], and Histology, 2020, 2021

Histology	2020 Estimated Cases			2021 Estimated Cases		
	All	Malignant	Non-Malignant	All	Malignant	Non-Malignant
Tumors of Neuroepithelial Tissue	**23,110**	**21,370**	**1,740**	**23,300**	**21,530**	**1,770**
Pilocytic Astrocytoma	960	960	--	950	950	--
Diffuse Astrocytoma	1,420	1,420	--	1,410	1,410	--
Anaplastic Astrocytoma	1,350	1,350	--	1,340	1,340	--
Unique Astrocytoma Variants	130	100	--	120	90	--
Glioblastoma	12,800	12,800	--	12,970	12,970	--
Oligodendroglioma	730	730	--	730	730	--
Anaplastic Oligodendroglioma	420	420	--	430	430	--
Oligoastrocytic Tumors	--	--	--	--	--	--
Ependymal Tumors	1,310	760	540	1,290	760	540
Glioma Malignant, NOS	1,920	1,920	--	1,990	1,990	--
Choroid Plexus Tumors	150	--	140	150	--	130
Other Neuroepithelial Tumors	--	--	--	--	--	--
Neuronal and Mixed Neuronal Glial Tumors	1,110	140	960	1,130	130	1,000
Tumors of the Pineal Region	130	80	--	120	80	--
Embryonal Tumors	650	640	--	640	630	--
Tumors of Cranial and Spinal Nerves	**5,910**	**--**	**5,870**	**5,670**	**--**	**5,630**
Nerve Sheath Tumors	5,910	--	5,870	5,670	--	5,630
Tumors of Meninges	**35,260**	**400**	**34,850**	**35,800**	**390**	**35,410**
Meningioma	34,300	240	34,060	34,840	220	34,620
Mesenchymal Tumors	330	120	210	340	130	220
Primary Melanocytic Lesions	--	--	--	--	--	--
Other Neoplasms Related to the Meninges	600	--	--	600	--	--
Lymphomas and Hematopoietic Neoplasms	**1,810**	**1,810**	**--**	**1,850**	**1,850**	**--**
Lymphoma	1,770	1,770	--	1,820	1,820	--
Other Hematopoietic Neoplasms	--	--	--	--	--	--
Germ Cell Tumors and Cysts	**350**	**260**	**90**	**360**	**270**	**90**
Germ Cell Tumors, Cysts and Heterotopias	350	260	90	360	270	90
Tumors of Sellar Region	14,430	--	14,420	14,370	--	14,360
Tumors of the Pituitary	13,830	--	13,820	13,770	--	13,760
Craniopharyngioma	600	--	600	600	--	600
Unclassified Tumors	**2,950**	**1,080**	**1,870**	**2,810**	**1,040**	**1,770**
Hemangioma	700	--	690	640	--	630
Neoplasm Unspecified	2,100	1,040	1,050	1,970	990	980
All Other	150	--	120	200	--	170
TOTAL	**83,830**	**24,970**	**58,860**	**84,170**	**25,130**	**59,040**

a. Source: Estimation based on CBTRUS NPCR and SEER 2000-2017 data for malignant tumors, and NPCR and SEER 2006-2017 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 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, 2013-2017[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	1,476	295	5.12	4.86-5.40	819	164	6.25	5.81-6.70	657	131	4.20	3.87-4.54
Alaska	147	29	4.18	3.49-4.97	74	15	4.08	3.12-5.24	73	15	4.26	3.29-5.42
Arizona	1,708	342	4.27	4.07-4.48	963	193	5.10	4.78-5.44	745	149	3.53	3.27-3.80
Arkansas	873	175	4.94	4.61-5.28	492	98	6.10	5.56-6.68	381	76	3.97	3.57-4.41
California	8,972	1,794	4.34	4.25-4.43	5,084	1,017	5.32	5.17-5.47	3,888	778	3.50	3.39-3.61
Colorado	1,279	256	4.37	4.13-4.63	691	138	4.98	4.60-5.38	588	118	3.84	3.53-4.17
Connecticut	945	189	4.34	4.06-4.64	540	108	5.44	4.98-5.93	405	81	3.43	3.09-3.80
Delaware	252	50	4.27	3.75-4.86	137	27	5.14	4.29-6.11	115	23	3.60	2.95-4.36
Washington DC	78	16	2.28	1.80-2.87	48	10	3.12	2.28-4.17	30	6	1.61	1.08-2.34
Florida	5,635	1,127	4.18	4.07-4.30	3,157	631	5.09	4.91-5.27	2,478	496	3.38	3.24-3.52
Georgia	2,275	455	4.27	4.09-4.45	1,269	254	5.22	4.92-5.52	1,006	201	3.47	3.26-3.70
Hawaii	253	51	2.92	2.56-3.32	140	28	3.43	2.87-4.07	113	23	2.43	1.99-2.95
Idaho	480	96	5.13	4.67-5.63	306	61	6.93	6.16-7.78	174	35	3.53	3.01-4.11
Illinois	3,037	607	4.18	4.03-4.33	1,691	338	5.11	4.86-5.36	1,346	269	3.40	3.22-3.60
Indiana	1,705	341	4.55	4.34-4.78	987	197	5.68	5.32-6.06	718	144	3.58	3.32-3.86
Iowa	943	189	5.07	4.75-5.42	531	106	6.09	5.57-6.65	412	82	4.14	3.74-4.58
Kansas	816	163	4.97	4.63-5.33	460	92	5.94	5.39-6.52	356	71	4.12	3.69-4.59
Kentucky	1,253	251	4.84	4.57-5.12	694	139	5.78	5.35-6.24	559	112	4.00	3.67-4.36
Louisiana	1,133	227	4.37	4.11-4.63	613	123	5.19	4.78-5.63	520	104	3.69	3.37-4.03
Maine	465	93	5.13	4.65-5.65	278	56	6.58	5.80-7.44	187	37	3.88	3.31-4.53
Maryland	1,378	276	4.10	3.88-4.32	761	152	4.98	4.62-5.36	617	123	3.34	3.08-3.63
Massachusetts	1,857	371	4.60	4.39-4.82	1,040	208	5.69	5.34-6.06	817	163	3.72	3.46-3.99
Michigan	2,793	559	4.64	4.46-4.82	1,577	315	5.71	5.42-6.01	1,216	243	3.73	3.52-3.95
Minnesota	1,472	294	4.71	4.46-4.96	872	174	5.90	5.50-6.31	600	120	3.66	3.36-3.98
Mississippi	869	174	5.12	4.78-5.48	460	92	6.10	5.54-6.70	409	82	4.36	3.94-4.82
Missouri	1,596	319	4.38	4.16-4.61	887	177	5.34	4.99-5.71	709	142	3.58	3.31-3.86
Montana	312	62	4.72	4.19-5.30	178	36	5.61	4.78-6.54	134	27	3.91	3.25-4.67
Nebraska	540	108	5.05	4.62-5.51	307	61	6.08	5.41-6.82	233	47	4.16	3.63-4.76
Nevada	735	147	4.55	4.22-4.91	405	81	5.20	4.69-5.75	330	66	3.94	3.52-4.40
New Hampshire	401	80	4.83	4.35-5.35	229	46	5.82	5.06-6.67	172	34	4.00	3.40-4.69

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 Jersey	2,157	431	4.12	3.94-4.30	1,200	240	5.03	4.75-5.34	957	191	3.37	3.16-3.60
New Mexico	467	93	3.79	3.45-4.16	258	52	4.44	3.90-5.03	209	42	3.23	2.79-3.71
New York	4,444	889	3.85	3.74-3.97	2,437	487	4.68	4.49-4.87	2,007	401	3.18	3.04-3.33
North Carolina	2,482	496	4.31	4.14-4.49	1,349	270	5.19	4.91-5.49	1,133	227	3.58	3.37-3.80
North Dakota	186	37	4.41	3.78-5.11	112	22	5.63	4.61-6.81	74	15	3.37	2.63-4.26
Ohio	3,263	653	4.66	4.50-4.83	1,838	368	5.69	5.43-5.97	1,425	285	3.78	3.58-3.99
Oklahoma	1,054	211	4.81	4.51-5.11	587	117	5.77	5.30-6.27	467	93	3.97	3.61-4.35
Oregon	1,214	243	4.97	4.68-5.27	694	139	5.99	5.54-6.47	520	104	4.05	3.70-4.43
Pennsylvania	3,596	719	4.46	4.31-4.61	2,023	405	5.51	5.26-5.76	1,573	315	3.60	3.41-3.79
Rhode Island	306	61	4.72	4.19-5.31	167	33	5.67	4.82-6.64	139	28	3.94	3.29-4.69
South Carolina	1,347	269	4.59	4.34-4.85	745	149	5.55	5.15-5.98	602	120	3.80	3.49-4.13
South Dakota	271	54	5.31	4.67-6.00	156	31	6.39	5.40-7.51	115	23	4.49	3.67-5.44
Tennessee	1,855	371	4.84	4.62-5.07	1,069	214	6.07	5.70-6.46	786	157	3.78	3.51-4.06
Texas	5,676	1,135	4.21	4.10-4.32	3,127	625	4.98	4.80-5.16	2,549	510	3.55	3.42-3.70
Utah	612	122	4.70	4.33-5.10	375	75	6.06	5.45-6.72	237	47	3.46	3.03-3.94
Vermont	228	46	5.76	5.01-6.61	123	25	6.71	5.53-8.08	105	21	5.00	4.05-6.14
Virginia	1,960	392	4.17	3.98-4.36	1,052	210	4.91	4.61-5.23	908	182	3.56	3.33-3.80
Washington	2,010	402	4.96	4.74-5.18	1,155	231	5.97	5.62-6.34	855	171	4.04	3.76-4.33
West Virginia	566	113	4.70	4.31-5.12	315	63	5.55	4.93-6.23	251	50	3.94	3.45-4.49
Wisconsin	1,694	339	4.93	4.69-5.18	963	193	5.93	5.55-6.33	731	146	4.01	3.72-4.33
Wyoming	180	36	5.56	4.75-6.47	93	19	5.99	4.79-7.39	87	17	5.21	4.13-6.48
United States	**81,246**	**16,249**	**4.42**	**4.39-4.45**	**45,528**	**9,106**	**5.36**	**5.31-5.42**	**35,718**	**7,144**	**3.61**	**3.57-3.65**

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. (1990-2017) <Katrina/Rita Population Adjustment>, National Cancer Institute, DCCPS, Surveillance Research Program, released December 2019. Underlying mortality data provided by NCHS (www.cdc.gov/nchs).
- Counts and rates are not presented when fewer than 20 cases were reported for the specific category. The suppressed cases are included in the counts and rates for totals.
Abbreviations: NCHS, National Center for Health Statistics; CI, confidence interval.

Table 20. Ten-Year Total, Percentage of Total Deaths, and Average Annual Age-Adjusted Incidence-Based Mortality Rates[a] for Brain and Other Central Nervous System Cancer Overall and by Histology, United States, CBTRUS Statistical Report: SEER, 2008-2017[b]

Histology	Total deaths (2008-2017)	% of deaths due to Brain and Other CNS Tumors attributable to this histology	Rate (95% CI)
Tumors of Neuroepithelial Tissue	13,571	88.10%	4.2 (4.2-4.3)
Pilocytic Astrocytoma	95	0.60%	0.0 (0.0-0.0)
Diffuse Astrocytoma	940	6.10%	0.3 (0.3-0.3)
Anaplastic Astrocytoma	876	5.70%	0.3 (0.3-0.3)
Unique Astrocytoma Variants	62	0.40%	0.0 (0.0-0.0)
Glioblastoma	9,447	61.30%	2.9 (2.8-3.0)
Oligodendroglioma	462	3.00%	0.1 (0.1-0.2)
Anaplastic Oligodendroglioma	192	1.20%	0.1 (0.0-0.1)
Oligoastrocytic Tumors	319	2.10%	0.1 (0.1-0.1)
Ependymal Tumors	138	0.90%	0.0 (0.0-0.0)
Glioma Malignant, NOS	646	4.20%	0.2 (0.2-0.2)
Choroid Plexus Tumors	--	--	--
Other Neuroepithelial Tumors	--	--	--
Neuronal and Mixed Neuronal Glial Tumors	54	0.40%	0.0 (0.0-0.0)
Tumors of the Pineal Region	21	0.10%	0.0 (0.0-0.0)
Embryonal Tumors	297	1.90%	0.1 (0.1-0.1)
Tumors of Cranial and Spinal Nerves	**--**	**--**	**--**
Nerve Sheath Tumors	--	--	--
Other tumors of cranial and spinal nerves	--	--	--
Tumors of Meninges	215	1.40%	0.1 (0.1-0.1)
Meningioma	139	0.90%	0.0 (0.0-0.0)
Mesenchymal tumors	51	0.30%	0.0 (0.0-0.0)
Primary melanocytic lesions	--	--	--
Other neoplasms related to the meninges	--	--	--
Lymphomas and Hematopoietic Neoplasms	897	5.80%	0.3 (0.3-0.3)
Lymphoma	884	5.70%	0.3 (0.3-0.3)
Other hematopoietic neoplasms	--	--	--
Germ Cell Tumors and Cysts	42	0.30%	0.0 (0.0-0.0)
Germ cell tumors, cysts and heterotopias	42	0.30%	0.0 (0.0-0.0)
Tumors of Sellar Region	**--**	**--**	**--**
Tumors of the Pituitary	--	--	--
Craniopharyngioma	--	--	--
Unclassified Tumors	651	4.20%	0.2 (0.2-0.2)
Hemangioma	--	--	--
Neoplasm Unspecified	642	4.20%	0.2 (0.2-0.2)
All Other	--	--	--
TOTAL	**15,408**	**--**	**4.8 (4.7-4.9)**

a. Rates are per 100,000 and are age-adjusted to the 2000 US standard population.
b. Estimated by CBTRUS using Surveillance, Epidemiology, and End Results (SEER) Program (www.seer.cancer.gov) SEER*Stat Database: Incidence - SEER Research Data, 9 Registries, Nov 2019 Sub (1975-2017) - Linked To County Attributes - Time Dependent (1990-2017) Income/Rurality, 1969-2017 Counties, National Cancer Institute, DCCPS, Surveillance Research Program, released April 2020, based on the November 2019 submission.
- Counts and rates are not presented when fewer than 20 cases were reported for the specific category. The suppressed cases are included in the counts and rates for totals.
Abbreviations: NCHS, National Center for Health Statistics; CI, confidence interval.

Table 21. Sixteen-Year Total Deaths, and Median Survival in Months with 95% Confidence Intervals for Primary Malignant Brain and Other CNS Tumor Histologies, CBTRUS Statistical Report: NPCR, 2001-2016

Histology	N	Deaths	Median survival (95% CI)
Pilocytic Astrocytoma	12,068	822	** (** -**)
Diffuse Astrocytoma	18,420	9,662	36 (34-38)
Anaplastic Astrocytoma	13,643	9,509	18 (17-18)
Unique Astrocytoma Variants	1,564	637	44 (36-54)
Glioblastoma	113,412	103,642	8 (8-9)
Oligodendroglioma	9,062	2,362	119 (115-124)
Anaplastic Oligodendroglioma	3,943	1,723	60 (57-64)
Oligoastrocytic Tumors	6,087	2,618	71 (68-76)
Ependymal Tumors	9,344	1,831	** (155-**)
Glioma Malignant, NOS	16,323	7,403	37 (34-42)
Choroid Plexus Tumors	310	114	77 (57-107)
Other Neuroepithelial Tumors	151	46	88 (52-**)
Neuronal and Mixed Neuronal Glial Tumors	1,907	573	93 (85-109)
Tumors of the Pineal Region	888	295	75 (68-102)
Embryonal Tumors	8,422	3,201	66 (61-73)
Nerve Sheath Tumors	467	174	95 (68-135)
Meningioma	3,807	1,771	53 (48-58)
Mesenchymal Tumors	845	337	72 (56-85)
Primary Melanocytic Lesions	140	105	11 (7-17)
Other Neoplasms Related to the Meninges	579	190	83 (70-99)
Lymphoma	15,057	10,109	13 (13-14)
Other Hemopoietic Neoplasms	392	138	84 (49-140)
Germ Cell Tumors, Cysts and Heterotopias	2,442	327	** (** -**)
Tumors of the Pituitary	343	102	139 (113-**)
All Other	72	23	133 (35-**)
Neoplasm Unspecified	8,596	7,083	2 (2-2)

** cannot 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 22. Hazards Ratios[†] And 95% Confidence Intervals for Age Group, Sex, Race, and Ethnicity for Primary Malignant Brain and Other CNS Tumor Histologies, CBTRUS Statistical Report: NPCR, 2001-2016

Histology	N	Deaths	Age Groups				Sex		Race						Ethnicity	
			AYA[b] (15-39) Years		Adults (40+) Years		Female		Black		AIAN		API		Hispanic	
			HR (95% CI)	P-value	HR (95% CI)	P-value	HR (95% CI)	P-value	HR (95% CI)	P-value	HR (95% CI)	P-value	HR (95% CI)	P-value	HR (95% CI)	P-value
Pilocytic Astrocytoma	9,864	691	1.99 (1.64-2.41)	<0.0001	8.38 (6.97-10.06)	<0.0001	0.90 (0.78-1.05)	0.1728	1.36 (1.10-1.69)	0.0051	1.64 (0.82-3.30)	0.1639	0.47 (0.24-0.91)	0.0251	0.93 (0.73-1.18)	0.5476
Diffuse Astrocytoma	15,177	7,984	1.51 (1.33-1.72)	<0.0001	5.33 (4.73-6.00)	<0.0001	0.98 (0.94-1.02)	0.3615	1.08 (0.99-1.17)	0.0772	0.95 (0.74-1.22)	0.6898	0.86 (0.74-1.00)	0.0537	0.82 (0.74-0.89)	<0.0001
Anaplastic Astrocytoma	11,414	7,929	0.34 (0.31-0.39)	<0.0001	1.07 (0.97-1.19)	0.1800	0.99 (0.95-1.04)	0.6701	1.04 (0.95-1.13)	0.3694	1.01 (0.77-1.32)	0.9357	0.80 (0.69-0.93)	0.0041	0.78 (0.72-0.86)	<0.0001
Unique Astrocytoma Variants	1,269	511	1.30 (0.93-1.82)	0.1211	5.25 (3.88-7.10)	<0.0001	0.94 (0.79-1.13)	0.5260	0.72 (0.52-0.99)	0.0401	1.75 (0.86-3.54)	0.1203	0.88 (0.51-1.53)	0.6536	0.60 (0.43-0.85)	0.0034
Glioblastoma	92,191	84,294	0.72 (0.66-0.78)	<0.0001	1.57 (1.46-1.70)	<0.0001	1.00 (0.99-1.02)	0.6790	0.97 (0.94-1.00)	0.0407	1.02 (0.92-1.13)	0.7723	0.83 (0.79-0.88)	<0.0001	0.89 (0.86-0.92)	<0.0001
Oligodendroglioma	7,632	1,989	2.57 (1.54-4.30)	0.0003	5.62 (3.38-9.36)	<0.0001	0.86 (0.79-0.94)	0.0012	1.38 (1.16-1.64)	0.0003	0.97 (0.54-1.76)	0.9327	0.75 (0.55-1.01)	0.0556	0.64 (0.54-0.78)	<0.0001
Anaplastic Oligo-dendroglioma	3,320	1,474	0.36 (0.20-0.62)	0.0003	0.69 (0.40-1.20)	0.1938	0.99 (0.89-1.10)	0.8601	1.33 (1.08-1.64)	0.0065	0.46 (0.17-1.24)	0.1245	0.74 (0.55-0.99)	0.0423	0.79 (0.66-0.95)	0.0135
Oligoastrocytic Tumors	5,276	2,295	1.59 (1.08-2.34)	0.0181	3.48 (2.38-5.10)	<0.0001	0.94 (0.87-1.02)	0.1592	1.21 (1.02-1.42)	0.0243	1.25 (0.81-1.92)	0.3183	0.79 (0.61-1.04)	0.0939	0.78 (0.67-0.91)	0.0016
Ependymal Tumors	7,675	1,505	0.49 (0.42-0.57)	<0.0001	0.89 (0.79-1.01)	0.0610	0.75 (0.67-0.83)	<0.0001	1.29 (1.10-1.50)	0.0017	1.14 (0.72-1.82)	0.5766	0.79 (0.59-1.07)	0.1341	0.88 (0.75-1.02)	0.0956
Glioma Malignant, NOS	12,440	5,388	0.72 (0.65-0.79)	<0.0001	2.81 (2.64-3.00)	<0.0001	0.95 (0.90-1.00)	0.0408	1.11 (1.02-1.20)	0.0156	1.05 (0.77-1.42)	0.7671	1.01 (0.86-1.19)	0.8665	1.03 (0.95-1.13)	0.4658
Choroid Plexus Tumors	240	92	0.54 (0.26-1.11)	0.0962	1.20 (0.71-2.05)	0.4942	0.90 (0.59-1.37)	0.6170	1.04 (0.56-1.94)	0.9013	2.40 (0.71-8.09)	0.1597	4.93 (2.19-11.10)	0.0001	0.43 (0.23-0.83)	0.0124
Other Neuroepithelial Tumors	121	40	1.56 (0.42-5.82)	0.5048	7.49 (2.33-24.09)	0.0007	0.48 (0.24-0.94)	0.0317	0.76 (0.22-2.61)	0.6608	**	**	**	**	0.69 (0.23-2.03)	0.4994
Neuronal and Mixed Neuronal Glial Tumors	1,563	475	1.24 (0.82-1.89)	0.3086	1.49 (1.01-2.20)	0.0423	0.85 (0.70-1.02)	0.0782	1.30 (0.98-1.72)	0.0670	3.30 (1.62-6.71)	0.0010	0.90 (0.58-1.38)	0.6145	0.94 (0.70-1.27)	0.6923
Tumors of the Pineal Region	740	246	0.58 (0.42-0.80)	0.0008	1.00 (0.73-1.36)	0.9817	0.69 (0.54-0.89)	0.0049	0.99 (0.73-1.34)	0.9373	1.08 (0.39-2.94)	0.8864	0.38 (0.14-1.03)	0.0580	1.08 (0.75-1.56)	0.6697
Embryonal Tumors	6,834	2,605	0.80 (0.73-0.88)	<0.0001	1.66 (1.48-1.86)	<0.0001	1.01 (0.94-1.09)	0.7680	1.27 (1.13-1.43)	<0.0001	1.13 (0.76-1.68)	0.5392	0.95 (0.77-1.18)	0.6344	0.84 (0.76-0.93)	0.0012
Nerve Sheath Tumors	339	127	0.71 (0.32-1.56)	0.3922	0.86 (0.41-1.77)	0.6784	0.71 (0.50-1.02)	0.0631	1.31 (0.80-2.15)	0.2891	**	**	0.09 (0.01-0.65)	0.0167	1.23 (0.66-2.26)	0.5162
Meningioma	2,736	1,188	0.84 (0.43-1.66)	0.6184	2.11 (1.13-3.93)	0.0192	0.73 (0.65-0.81)	<0.0001	0.96 (0.83-1.12)	0.6068	0.57 (0.21-1.52)	0.2619	0.74 (0.55-1.01)	0.0544	0.70 (0.56-0.89)	0.0034
Mesenchymal Tumors	704	278	0.70 (0.45-1.09)	0.1161	0.98 (0.67-1.43)	0.9064	0.98 (0.77-1.24)	0.8657	1.10 (0.75-1.62)	0.6282	1.31 (0.48-3.55)	0.5956	0.56 (0.31-1.00)	0.0496	0.93 (0.63-1.36)	0.7010
Primary Melanocytic Lesions	100	76	0.42 (0.17-1.02)	0.0548	0.63 (0.30-1.31)	0.2140	0.83 (0.50-1.37)	0.4595	1.91 (0.66-5.49)	0.2321	**	**	1.19 (0.42-3.39)	0.7463	2.13 (0.89-5.11)	0.0897
Other Neoplasms Related to the Me-ninges	443	144	1.34 (0.46-3.93)	0.5880	3.09 (1.11-8.61)	0.0305	0.83 (0.59-1.16)	0.2743	0.99 (0.56-1.78)	0.9854	3.12 (0.98-9.90)	0.0535	0.63 (0.25-1.58)	0.3281	1.01 (0.59-1.73)	0.9620
Lymphoma	12,068	7,997	2.06 (1.21-3.50)	0.0079	3.74 (2.21-6.32)	<0.0001	0.93 (0.89-0.97)	0.0018	1.21 (1.12-1.31)	<0.0001	1.32 (1.03-1.70)	0.0276	0.86 (0.77-0.95)	0.0049	0.87 (0.80-0.94)	0.0006
Other Hemopoietic Neoplasms	316	112	3.14 (0.87-11.28)	0.0799	9.46 (2.98-30.04)	0.0001	0.85 (0.58-1.24)	0.3943	0.82 (0.48-1.39)	0.4568	0.98 (0.24-4.04)	0.9774	0.35 (0.09-1.45)	0.1490	1.09 (0.64-1.86)	0.7455

Table 22. Continued

Histology	N	Deaths	Age Groups				Sex		Race						Ethnicity	
			AYA[b] (15-39) Years		Adults (40+) Years		Female		Black		AIAN		API		Hispanic	
			HR (95% CI)	P-value	HR (95% CI)	P-value	HR (95% CI)	P-value	HR (95% CI)	P-value	HR (95% CI)	P-value	HR (95% CI)	P-value	HR (95% CI)	P-value
Germ Cell Tumors, Cysts and Heterotopias	2,027	269	0.98 (0.75-1.27)	0.8531	3.66 (2.35-5.70)	<0.0001	1.43 (1.09-1.89)	0.0110	0.85 (0.55-1.31)	0.4671	1.94 (0.62-6.11)	0.2561	0.60 (0.38-0.96)	0.0331	0.84 (0.61-1.16)	0.2863
Tumors of the Pituitary	261	77	**	**	**	**	0.58 (0.36-0.93)	0.0252	1.58 (0.94-2.65)	0.0866	1.16 (0.16-8.71)	0.8827	0.37 (0.05-2.73)	0.3320	0.76 (0.30-1.91)	0.5587
Neoplasm Unspecified	5,013	4,081	0.71 (0.56-0.90)	0.0040	2.32 (1.93-2.78)	<0.0001	0.98 (0.92-1.04)	0.4526	0.73 (0.66-0.81)	<0.0001	0.95 (0.67-1.34)	0.7667	0.90 (0.73-1.11)	0.3268	0.89 (0.78-1.00)	0.0541

a.Children as defined by the National Cancer Institute, see: http://www.cancer.gov/researchandfunding/snapshots/pediatric.
b.Adolescents and Young Adults (AYA), as defined by the National Cancer Institute, see: http://www.cancer.gov/cancertopics/aya.
[†]Reference Categories are Children (<14 years) for Age group, Male for Sex, White for Race, and Non-Hispanic for Ethnicity.
** Cannot be calculated.
Abbreviations: AYA, Adolescents and Young Adults; 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-, Five-, and Ten-Year Relative Survival Rates[a,b] with 95% Confidence Intervals for Brain and Other Central Nervous System Tumors Overall and by NCI Age Groups, CBTRUS Statistical Report: NPCR, 2004-2016[c]

Histology	All ages				0-14 years old				15-39 years old				40+ years old			
	N	1 year	5 year	10 year	N	1 year	5 year	10 year	N	1 year	5 year	10 year	N	1 year	5 year	10 year
Pilocytic Astrocytoma	12,067	98.0 (97.7-98.2)	94.5 (94.0-95.0)	93.0 (92.4-93.6)	7,178	98.9 (98.6-99.1)	97.1 (96.6-97.5)	96.0 (95.3-96.5)	3,654	98.4 (97.9-98.8)	94.8 (93.9-95.5)	92.9 (91.7-93.9)	1,235	91.3 (89.4-92.8)	78.6 (75.7-81.3)	76.1 (72.4-79.4)
Diffuse Astrocytoma	18,450	76.3 (75.6-76.9)	53.0 (52.2-53.8)	43.1 (42.1-44.0)	1,947	92.9 (91.6-93.9)	83.8 (82.0-85.4)	81.2 (79.1-83.1)	5,801	95.7 (95.1-96.2)	78.1 (76.8-79.2)	61.9 (60.1-63.6)	10,702	62.7 (61.7-63.6)	33.5 (32.5-34.6)	25.6 (24.5-26.7)
Anaplastic Astrocytoma	13,656	66.4 (65.6-67.2)	31.1 (30.2-32.0)	22.7 (21.7-23.7)	621	66.2 (62.3-69.8)	24.8 (21.2-28.6)	19.6 (15.9-23.7)	3,577	91.9 (90.9-92.7)	61.8 (59.9-63.7)	45.7 (43.2-48.1)	9,458	56.9 (55.8-57.9)	20.0 (19.1-20.9)	14.3 (13.3-15.3)
Unique Astrocytoma Variants	2,506	87.4 (86.0-88.7)	74.0 (72.1-75.9)	69.9 (67.6-72.2)	908	97.3 (96.0-98.2)	92.0 (89.8-93.8)	88.8 (85.6-91.4)	897	95.6 (94.0-96.8)	85.2 (82.4-87.6)	80.6 (77.1-83.7)	701	63.7 (59.8-67.3)	34.7 (30.6-38.8)	29.5 (24.8-34.4)
Malignant	*1,566*	*81.4 (79.3-83.3)*	*60.7 (57.9-63.3)*	*55.9 (52.7-59.0)*	*331*	*95.0 (91.9-96.9)*	*81.7 (76.5-85.9)*	*75.6 (68.4-81.4)*	*606*	*95.1 (93.0-96.6)*	*80.7 (76.8-84.0)*	*76.0 (71.3-80.0)*	*629*	*60.5 (56.4-64.4)*	*29.1 (25.0-33.4)*	*24.8 (20.2-29.7)*
Non-Malignant	*940*	*97.4 (96.1-98.3)*	*95.3 (93.5-96.6)*	*92.1 (89.1-94.3)*	*577*	*98.6 (97.2-99.3)*	*97.6 (95.9-98.7)*	*96.0 (92.6-97.9)*	*291*	*96.6 (93.6-98.2)*	*94.1 (90.2-96.4)*	*89.6 (83.4-93.6)*	*72*	*90.7 (80.4-95.7)*	*80.6 (67.4-88.9)*	*68.7 (48.3-82.4)*
Glioblastoma	113,422	42.8 (42.5-43.1)	7.2 (7.0-7.4)	4.7 (4.6-4.9)	1,040	57.5 (54.4-60.5)	19.6 (17.0-22.3)	16.3 (13.8-19.1)	5,809	76.3 (75.1-77.4)	26.8 (25.5-28.1)	18.8 (17.5-20.2)	106,573	40.8 (40.5-41.1)	5.9 (5.8-6.1)	3.8 (3.6-4.0)
Oligodendroglioma	9,068	94.9 (94.4-95.3)	83.4 (82.5-84.3)	69.6 (68.2-71.0)	294	97.6 (94.9-98.8)	94.1 (90.5-96.4)	91.9 (87.5-94.8)	3,656	98.6 (98.1-98.9)	91.7 (90.5-92.6)	76.4 (74.2-78.4)	5,118	92.0 (91.2-92.8)	76.8 (75.4-78.1)	63.2 (61.2-65.2)
Anaplastic Oligodendroglioma	3,946	87.7 (86.6-88.7)	64.0 (62.2-65.7)	49.7 (47.4-52.0)	--	--	--	--	1,131	95.8 (94.4-96.8)	78.4 (75.5-81.0)	60.8 (56.6-64.6)	2,779	84.4 (83.0-85.8)	58.0 (55.9-60.1)	45.0 (42.2-47.8)
Oligoastrocytic Tumors	6,092	89.6 (88.8-90.4)	67.6 (66.3-68.9)	52.3 (50.6-54.0)	162	91.3 (85.7-94.8)	80.5 (73.3-86.0)	78.6 (71.0-84.5)	2,687	97.5 (96.9-98.1)	81.6 (79.9-83.1)	61.1 (58.5-63.7)	3,243	82.9 (81.6-84.2)	55.2 (53.3-57.0)	43.5 (41.1-45.8)
Ependymal Tumors	15,690	96.0 (95.6-96.3)	90.6 (89.9-91.1)	86.3 (85.4-87.2)	2,239	95.7 (94.8-96.5)	80.4 (78.4-82.1)	71.5 (68.9-74.0)	4,643	98.2 (97.8-98.6)	94.9 (94.1-95.6)	91.4 (90.1-92.5)	8,808	94.9 (94.3-95.4)	90.9 (90.0-91.8)	87.5 (86.1-88.9)
Malignant	*9,170*	*94.8 (94.3-95.3)*	*86.5 (85.7-87.4)*	*81.0 (79.7-82.2)*	*1,987*	*95.3 (94.3-96.2)*	*78.3 (76.2-80.3)*	*68.5 (65.7-71.2)*	*2,567*	*97.2 (96.5-97.8)*	*91.9 (90.7-93.1)*	*87.1 (85.1-88.7)*	*4,616*	*93.3 (92.4-94.0)*	*87.1 (85.8-88.3)*	*83.0 (81.0-84.8)*
Non-Malignant	*6,520*	*97.7 (97.2-98.1)*	*96.4 (95.6-97.1)*	*94.4 (92.9-95.6)*	*252*	*98.8 (96.2-99.6)*	*96.8 (93.1-98.5)*	*96.1 (92.0-98.1)*	*2,076*	*99.5 (99.0-99.7)*	*98.6 (97.7-99.2)*	*97.0 (95.4-98.1)*	*4,192*	*96.7 (96.0-97.3)*	*95.3 (94.0-96.3)*	*92.9 (90.5-94.7)*
Glioma Malignant, NOS	16,380	71.9 (71.2-72.6)	57.5 (56.6-58.3)	52.8 (51.8-53.8)	5,711	82.9 (81.9-83.9)	70.5 (69.2-71.8)	69.4 (68.0-70.7)	3,378	92.6 (91.7-93.5)	79.4 (77.8-80.9)	71.7 (69.5-73.8)	7,291	53.2 (52.0-54.4)	36.5 (35.2-37.7)	30.0 (28.5-31.6)
Choroid Plexus Tumors	1,986	93.8 (92.6-94.8)	89.4 (87.7-90.9)	86.1 (83.6-88.1)	868	95.2 (93.5-96.5)	89.9 (87.4-91.9)	87.5 (84.5-90.0)	524	97.9 (96.2-98.9)	95.8 (93.3-97.4)	91.8 (87.6-94.7)	594	88.1 (84.9-90.6)	83.0 (78.7-86.6)	78.6 (71.9-83.8)
Malignant	*308*	*86.0 (81.4-89.5)*	*68.8 (62.6-74.2)*	*57.9 (50.4-64.8)*	*229*	*86.6 (81.4-90.5)*	*68.6 (61.3-74.9)*	*61.1 (52.5-68.6)*	--	--	--	--	--	--	--	--
Non-Malignant	*1,678*	*95.2 (94.0-96.2)*	*93.2 (91.5-94.5)*	*91.1 (88.6-93.1)*	*639*	*98.3 (96.8-99.1)*	*97.2 (95.3-98.3)*	*96.4 (93.8-97.9)*	--	--	--	--	--	--	--	--
Other Neuroepithelial Tumors	240	84.3 (78.8-88.5)	72.5 (65.5-78.4)	66.5 (57.7-73.8)	64	96.7 (87.1-99.2)	88.4 (75.6-94.7)	88.4 (75.6-94.7)	78	94.7 (86.2-98.0)	87.8 (76.5-93.9)	83.1 (69.8-90.9)	98	68.4 (57.7-76.8)	50.3 (38.5-61.0)	39.9 (26.1-53.3)
Malignant	*151*	*84.4 (77.2-89.5)*	*70.7 (61.5-78.1)*	*62.9 (51.2-72.5)*	--	--	--	--	--	--	--	--	--	--	--	--
Non-Malignant	*89*	*84.2 (74.3-90.5)*	*75.6 (63.7-84.1)*	*71.8 (57.2-82.1)*	--	--	--	--	--	--	--	--	--	--	--	--

Table 23. Continued

Histology	All ages				0-14 years old				15-39 years old				40+ years old			
	N	1 year	5 year	10 year	N	1 year	5 year	10 year	N	1 year	5 year	10 year	N	1 year	5 year	10 year
Neuronal and Mixed Neuronal Glial Tumors	10,632	96.8 (96.4-97.1)	92.0 (91.3-92.6)	89.0 (88.0-89.9)	2,751	98.6 (98.0-99.0)	95.8 (94.8-96.5)	94.7 (93.5-95.7)	4,370	98.2 (97.8-98.6)	95.2 (94.4-95.9)	91.9 (90.6-93.0)	3,511	93.5 (92.5-94.3)	84.8 (83.2-86.3)	80.6 (78.3-82.6)
Malignant	*1,930*	*91.5 (90.0-92.7)*	*76.9 (74.5-79.1)*	*69.9 (66.6-73.0)*	*167*	*88.2 (82.0-92.3)*	*77.0 (69.1-83.1)*	*75.9 (67.8-82.2)*	*465*	*93.9 (91.2-95.8)*	*76.3 (71.7-80.3)*	*66.5 (60.2-72.1)*	*1,298*	*91.0 (89.2-92.6)*	*77.1 (74.0-79.9)*	*69.9 (65.6-73.8)*
Non-Malignant	*8,702*	*97.9 (97.6-98.2)*	*95.3 (94.7-95.8)*	*93.2 (92.3-94.1)*	*2,584*	*99.2 (98.8-99.5)*	*97.0 (96.1-97.7)*	*95.9 (94.7-96.8)*	*3,905*	*98.8 (98.3-99.1)*	*97.5 (96.8-98.0)*	*95.0 (93.8-96.0)*	*2,213*	*94.9 (93.8-95.8)*	*89.3 (87.4-90.9)*	*86.7 (84.0-89.0)*
Tumors of the Pineal Region	1,659	92.3 (90.8-93.6)	79.3 (76.8-81.5)	72.9 (69.5-75.9)	349	90.1 (86.4-92.9)	69.2 (63.4-74.3)	62.6 (56.0-68.5)	629	95.3 (93.2-96.7)	85.3 (81.8-88.2)	80.3 (75.5-84.3)	681	90.7 (88.0-92.8)	79.0 (74.7-82.6)	71.3 (64.9-76.7)
Malignant	*893*	*89.8 (87.6-91.7)*	*68.8 (65.1-72.3)*	*59.5 (54.7-63.9)*	*295*	*88.7 (84.4-91.9)*	*63.6 (56.9-69.4)*	*56.1 (48.7-62.9)*	*318*	*92.8 (89.2-95.2)*	*73.6 (67.3-78.8)*	*64.6 (56.4-71.6)*	*280*	*87.6 (82.8-91.1)*	*69.1 (61.9-75.2)*	*56.5 (47.1-64.9)*
Non-Malignant	*766*	*95.2 (93.2-96.6)*	*91.4 (88.3-93.7)*	*88.4 (83.5-91.9)*	*54*	*98.1 (86.7-99.7)*	*98.1 (86.7-99.7)*	*94.8 (78.8-98.8)*	*311*	*97.7 (95.2-98.9)*	*96.8 (93.5-98.4)*	*95.5 (90.9-97.8)*	*401*	*92.8 (89.4-95.1)*	*85.9 (80.3-90.0)*	*81.2 (72.1-87.5)*
Embryonal Tumors	8,716	83.4 (82.6-84.2)	64.6 (63.5-65.7)	58.1 (56.8-59.4)	5,722	82.0 (80.9-83.0)	63.9 (62.5-65.2)	59.2 (57.6-60.6)	2,114	91.5 (90.1-92.6)	72.0 (69.8-74.0)	61.8 (59.1-64.4)	880	73.5 (70.3-76.3)	51.1 (47.3-54.7)	42.8 (38.3-47.1)
Malignant	*8,452*	*82.9 (82.1-83.7)*	*63.5 (62.4-64.7)*	*57.0 (55.7-58.3)*	*5,667*	*81.8 (80.7-82.8)*	*63.6 (62.2-64.9)*	*58.7 (57.2-60.3)*	*2,021*	*91.1 (89.7-92.2)*	*70.7 (68.4-72.8)*	*60.3 (57.4-62.9)*	*764*	*70.0 (66.5-73.2)*	*44.6 (40.6-48.5)*	*35.7 (31.1-40.4)*
Non-Malignant	*264*	*98.1 (95.0-99.3)*	*97.3 (92.1-99.1)*	*93.3 (85.3-97.0)*	*55*	*98.2 (87.3-99.8)*	*98.2 (87.3-99.8)*	*98.2 (87.3-99.8)*	*93*	*100.0 (**-**)*	*100.0 (**-**)*	*97.7 (65.7-99.9)*	*116*	*96.5 (89.6-98.9)*	*94.2 (83.1-98.1)*	*87.5 (72.4-94.7)*
Nerve Sheath Tumors	76,644	99.2 (99.1-99.3)	99.2 (99.1-99.3)	99.2 (99.1-99.3)	2,095	99.7 (99.3-99.9)	98.7 (98.0-99.1)	98.1 (97.2-98.7)	11,798	99.3 (99.1-99.4)	98.4 (98.1-98.7)	97.4 (96.9-97.9)	62,751	99.2 (99.0-99.3)	99.2 (99.0-99.3)	99.2 (99.0-99.3)
Malignant	*472*	*82.8 (78.9-86.1)*	*70.1 (65.0-74.6)*	*67.8 (61.2-73.6)*	--	--	--	--	*121*	*81.1 (72.7-87.2)*	*66.9 (57.2-74.9)*	*64.6 (54.6-73.0)*	*318*	*83.0 (78.0-86.9)*	*71.0 (64.4-76.6)*	*68.3 (58.9-76.0)*
Non-Malignant	*76,172*	*99.3 (99.2-99.4)*	*99.3 (99.2-99.4)*	*99.3 (99.2-99.4)*	--	--	--	--	*11,677*	*99.5 (99.3-99.6)*	*98.7 (98.4-99.0)*	*97.8 (97.2-98.2)*	*62,433*	*99.2 (99.1-99.4)*	*99.2 (99.1-99.4)*	*99.2 (99.1-99.4)*
Other Tumors of Cranial and Spinal Nerves	58	95.7 (82.6-99.0)	90.4 (73.8-96.7)	82.4 (57.7-93.4)	--	--	--	--	--	--	--	--	--	--	--	--
Meningioma	328,639	93.0 (92.9-93.2)	87.9 (87.7-88.1)	83.4 (83.1-83.8)	619	97.6 (95.9-98.5)	94.2 (91.8-95.9)	89.1 (85.0-92.1)	20,793	98.7 (98.5-98.9)	96.8 (96.5-97.1)	94.5 (94.0-95.0)	307,227	92.6 (92.5-92.8)	87.2 (87.0-87.4)	82.6 (82.2-82.9)
Malignant	*3,820*	*83.9 (82.5-85.1)*	*66.6 (64.6-68.5)*	*59.6 (57.0-62.1)*	*52*	*90.0 (77.4-95.8)*	*77.6 (61.9-87.4)*	*70.3 (52.5-82.4)*	*303*	*93.0 (89.4-95.4)*	*81.3 (75.9-85.6)*	*73.6 (66.3-79.5)*	*3,465*	*82.9 (81.5-84.3)*	*65.0 (62.9-67.1)*	*58.0 (55.4-60.6)*
Non-Malignant	*324,819*	*93.2 (93.0-93.3)*	*88.1 (87.9-88.3)*	*83.7 (83.4-84.1)*	*567*	*98.2 (96.7-99.1)*	*95.6 (93.3-97.1)*	*90.7 (86.5-93.7)*	*20,490*	*98.8 (98.6-98.9)*	*97.1 (96.8-97.3)*	*94.9 (94.4-95.3)*	*303,762*	*92.8 (92.6-92.9)*	*87.5 (87.3-87.7)*	*82.9 (82.5-83.2)*
Mesenchymal Tumors	3,522	94.0 (93.1-94.8)	86.3 (84.8-87.7)	79.2 (76.7-81.4)	720	96.6 (94.9-97.8)	92.3 (89.7-94.3)	91.3 (88.4-93.5)	826	96.8 (95.3-97.9)	91.9 (89.4-93.8)	86.8 (83.0-89.9)	1,976	91.9 (90.4-93.1)	81.9 (79.5-84.0)	72.3 (68.5-75.7)
Malignant	*854*	*84.7 (82.0-87.1)*	*65.5 (61.5-69.1)*	*53.8 (48.3-59.0)*	*112*	*79.6 (70.7-86.1)*	*64.8 (54.2-73.5)*	*63.0 (52.0-72.1)*	*212*	*90.3 (85.3-93.7)*	*74.6 (67.3-80.6)*	*64.5 (54.6-72.8)*	*530*	*83.5 (79.8-86.6)*	*61.7 (56.4-66.6)*	*47.6 (40.1-54.7)*
Non-Malignant	*2,668*	*97.0 (96.1-97.6)*	*93.0 (91.5-94.3)*	*87.4 (84.7-89.7)*	*608*	*99.8 (96.4-100.0)*	*97.8 (95.6-98.9)*	*96.9 (94.3-98.3)*	*614*	*99.1 (97.8-99.6)*	*97.7 (95.6-98.8)*	*94.5 (90.4-96.9)*	*1,446*	*94.9 (93.4-96.0)*	*89.1 (86.5-91.2)*	*81.2 (76.8-84.8)*

Table 23. Continued

Histology	All ages				0-14 years old				15-39 years old				40+ years old			
	N	1 year	5 year	10 year	N	1 year	5 year	10 year	N	1 year	5 year	10 year	N	1 year	5 year	10 year
Primary Melanocytic Lesions	228	65.7 (58.9-71.6)	44.7 (37.1-52.0)	33.3 (24.1-42.7)	--	--	--	--	--	--	--	--	162	66.6 (58.4-73.5)	43.0 (33.8-51.8)	32.6 (22.0-43.6)
Malignant	*141*	*52.7 (43.9-60.8)*	*32.0 (23.5-40.7)*	*22.4 (12.5-34.1)*	--	--	--	--	--	--	--	--	*99*	*55.9 (45.2-65.4)*	*32.9 (22.7-43.5)*	*25.8 (13.2-40.3)*
Non-Malignant	*87*	*86.8 (76.9-92.6)*	*64.8 (51.4-75.3)*	*49.1 (32.4-63.8)*	--	--	--	--	--	--	--	--	*63*	*83.3 (70.6-90.9)*	*57.7 (41.0-71.2)*	*41.4 (23.4-58.5)*
Other Neoplasms Related to the Meninges	7,032	96.2 (95.6-96.6)	92.9 (92.0-93.7)	88.7 (87.1-90.1)	135	97.8 (93.2-99.3)	93.1 (86.3-96.6)	86.2 (75.2-92.5)	2,212	98.3 (97.6-98.8)	96.0 (94.9-96.9)	93.5 (91.7-94.9)	4,685	95.1 (94.3-95.8)	91.4 (90.1-92.5)	86.4 (84.1-88.3)
Malignant	*610*	*94.4 (91.9-96.1)*	*78.9 (74.4-82.7)*	*67.9 (61.5-73.5)*	--	--	--	--	*179*	*96.6 (92.4-98.5)*	*86.6 (79.7-91.2)*	*84.7 (77.2-89.9)*	*401*	*93.2 (89.7-95.5)*	*74.5 (68.2-79.7)*	*58.3 (49.5-66.2)*
Non-Malignant	*6,422*	*96.3 (95.8-96.8)*	*94.2 (93.3-95.0)*	*90.7 (89.1-92.1)*	--	--	--	--	*2,033*	*98.4 (97.7-98.9)*	*96.9 (95.8-97.6)*	*94.2 (92.4-95.6)*	*4,284*	*95.3 (94.5-96.0)*	*92.9 (91.6-94.1)*	*89.0 (86.6-91.0)*
Lymphoma	15,058	55.0 (54.2-55.8)	37.6 (36.7-38.5)	29.7 (28.6-30.8)	66	90.5 (80.0-95.6)	78.3 (65.4-86.8)	68.6 (52.1-80.4)	1,344	65.2 (62.5-67.7)	56.8 (54.0-59.6)	52.0 (48.7-55.2)	13,648	53.8 (52.9-54.7)	35.3 (34.4-36.3)	27.0 (25.8-28.2)
Other Hemopoietic Neoplasms	395	83.6 (79.3-87.1)	67.3 (61.4-72.5)	65.3 (57.6-71.9)	80	94.7 (86.4-98.0)	94.7 (86.4-98.0)	89.5 (71.2-96.5)	78	91.6 (82.2-96.2)	75.7 (61.2-85.4)	75.7 (61.2-85.4)	237	77.4 (71.2-82.5)	56.3 (48.6-63.3)	54.8 (45.5-63.2)
Germ Cell Tumors, Cysts and Heterotopias	3,702	94.8 (94.0-95.5)	90.3 (89.2-91.4)	87.6 (86.0-89.0)	1,507	94.3 (93.0-95.4)	90.6 (88.9-92.1)	88.0 (85.7-90.0)	1,676	96.1 (95.0-97.0)	90.7 (89.0-92.2)	89.3 (87.3-91.0)	519	92.3 (89.3-94.5)	88.3 (83.8-91.6)	80.6 (73.1-86.2)
Malignant	*2,450*	*93.7 (92.6-94.6)*	*87.9 (86.4-89.3)*	*85.3 (83.4-87.0)*	*1,105*	*93.2 (91.5-94.6)*	*88.3 (86.1-90.2)*	*84.9 (82.0-87.4)*	*1,275*	*95.1 (93.7-96.2)*	*88.9 (86.8-90.6)*	*87.2 (84.7-89.2)*	*70*	*75.9 (63.5-84.6)*	*65.5 (51.4-76.4)*	*54.2 (34.6-70.2)*
Non-Malignant	*1,252*	*97.1 (95.8-98.0)*	*95.0 (93.0-96.5)*	*92.1 (88.9-94.4)*	*402*	*97.3 (95.0-98.5)*	*97.0 (94.6-98.3)*	*96.6 (93.9-98.1)*	*401*	*99.3 (97.5-99.8)*	*96.6 (93.6-98.2)*	*95.5 (91.2-97.7)*	*449*	*94.9 (91.9-96.8)*	*91.9 (86.9-95.0)*	*84.8 (76.4-90.5)*
Tumors of the Pituitary	145,970	98.1 (98.0-98.2)	96.8 (96.6-97.0)	95.2 (94.8-95.5)	1,967	99.9 (99.5-100.0)	99.4 (98.8-99.7)	98.9 (98.0-99.4)	43,972	99.7 (99.6-99.7)	99.3 (99.1-99.4)	98.6 (98.4-98.8)	100,031	97.4 (97.3-97.5)	95.7 (95.4-95.9)	93.5 (93.0-94.0)
Malignant	*346*	*91.1 (87.1-93.8)*	*81.9 (75.8-86.5)*	*78.7 (69.7-85.2)*	--	--	--	--	*63*	*100.0 (**-**)*	*90.0 (76.2-96.0)*	*90.0 (76.2-96.0)*	*280*	*88.9 (84.1-92.3)*	*79.8 (72.6-85.2)*	*75.4 (64.4-83.4)*
Non-Malignant	*145,624*	*98.2 (98.1-98.2)*	*96.9 (96.7-97.0)*	*95.2 (94.9-95.6)*	--	--	--	--	*43,909*	*99.7 (99.6-99.7)*	*99.3 (99.2-99.4)*	*98.6 (98.4-98.8)*	*99,751*	*97.4 (97.3-97.6)*	*95.7 (95.4-96.0)*	*93.5 (93.0-94.0)*
Craniopharyngioma	7,204	93.1 (92.5-93.7)	86.2 (85.2-87.2)	80.5 (79.0-81.9)	1,649	98.6 (97.9-99.1)	95.4 (94.1-96.4)	92.5 (90.6-94.1)	1,743	96.1 (95.0-96.9)	91.6 (90.0-93.0)	88.2 (86.1-90.1)	3,812	89.3 (88.2-90.3)	79.5 (77.8-81.1)	70.9 (68.3-73.3)
Hemangioma	11,408	96.8 (96.4-97.2)	94.0 (93.3-94.6)	91.7 (90.4-92.9)	712	99.2 (98.1-99.7)	97.7 (96.0-98.7)	97.7 (96.0-98.7)	3,197	99.5 (99.2-99.7)	98.8 (98.1-99.2)	96.8 (95.4-97.8)	7,499	95.4 (94.8-95.9)	91.5 (90.4-92.5)	88.8 (86.7-90.6)
Neoplasm Unspecified	24,689	60.9 (60.3-61.6)	53.1 (52.3-53.8)	49.1 (48.2-50.0)	1,294	87.2 (85.2-88.9)	84.1 (81.8-86.0)	82.5 (80.0-84.8)	3,829	93.0 (92.1-93.8)	89.6 (88.5-90.6)	87.8 (86.4-89.1)	19,566	52.7 (51.9-53.4)	43.5 (42.7-44.3)	38.6 (37.5-39.7)
Malignant	*8,596*	*31.2 (30.2-32.2)*	*21.7 (20.7-22.7)*	*19.3 (18.2-20.5)*	*322*	*63.2 (57.5-68.3)*	*54.4 (48.4-59.9)*	*51.9 (45.7-57.7)*	*632*	*78.4 (75.0-81.5)*	*68.2 (64.1-72.0)*	*65.2 (60.6-69.3)*	*7,642*	*25.8 (24.7-26.8)*	*16.2 (15.3-17.2)*	*13.9 (12.8-15.0)*

Table 23. Continued

Histology	All ages				0-14 years old				15-39 years old				40+ years old			
	N	1 year	5 year	10 year	N	1 year	5 year	10 year	N	1 year	5 year	10 year	N	1 year	5 year	10 year
Non-Malignant	*16,093*	*76.6 (75.9-77.3)*	*69.7 (68.8-70.6)*	*64.8 (63.7-66.0)*	*972*	*95.1 (93.5-96.4)*	*93.9 (92.1-95.3)*	*92.7 (90.2-94.6)*	*3,197*	*95.9 (95.1-96.5)*	*93.8 (92.8-94.7)*	*92.3 (91.0-93.5)*	*11,924*	*69.8 (68.9-70.7)*	*60.9 (59.8-62.0)*	*54.5 (52.9-56.0)*
All Other	327	83.4 (78.2-87.4)	74.3 (67.0-80.2)	67.8 (58.3-75.7)	–	–	–	–	50	93.8 (81.6-98.0)	77.2 (61.3-87.2)	77.2 (61.3-87.2)	228	79.7 (72.9-85.0)	73.5 (63.7-81.0)	63.2 (49.9-73.8)
Malignant	*78*	*78.0 (66.2-86.0)*	*59.6 (45.6-71.1)*	*56.5 (41.2-69.2)*	--	--	--	--	--	--	--	--	--	--	--	--
Non-Malignant	*249*	*85.1 (79.1-89.5)*	*78.9 (70.5-85.1)*	*71.5 (59.2-80.6)*	--	--	--	--	--	--	--	--	--	--	--	--
TOTAL[d]	**859,821**	**85.1 (85.0-85.1)**	**75.2 (75.1-75.3)**	**71.5 (71.3-71.7)**	**40,843**	**91.4 (91.1-91.7)**	**82.5 (82.1-82.9)**	**79.9 (79.5-80.4)**	**134,619**	**96.8 (96.7-96.9)**	**90.4 (90.2-90.6)**	**86.0 (85.8-86.3)**	**684,359**	**82.3 (82.2-82.4)**	**71.7 (71.5-71.8)**	**68.0 (67.8-68.2)**
Malignant	***248,005***	***61.1 (60.9-61.3)***	***36.0 (35.8-36.2)***	***30.9 (30.6-31.1)***	***27,371***	***87.7 (87.3-88.1)***	***75.4 (74.8-75.9)***	***72.2 (71.6-72.8)***	***39,902***	***91.3 (91.0-91.5)***	***72.5 (72.0-73.0)***	***61.9 (61.2-62.5)***	***180,732***	***50.3 (50.0-50.5)***	***21.5 (21.3-21.7)***	***17.2 (17.0-17.4)***
Non-Malignant	***611,816***	***94.9 (94.9-95.0)***	***91.7 (91.5-91.8)***	***88.8 (88.6-89.0)***	***13,472***	***98.8 (98.6-99.0)***	***97.3 (97.0-97.6)***	***96.0 (95.5-96.4)***	***94,717***	***99.2 (99.1-99.2)***	***98.2 (98.0-98.3)***	***96.8 (96.6-97.0)***	***503,627***	***94.0 (93.9-94.1)***	***90.2 (90.1-90.4)***	***87.0 (86.7-87.2)***

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. 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.
c.Total number of cases that occurred within the NPCR registries between 2004 and 2016.
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 24. Summary of Biomarkers Identified for Primary Brain and Other CNS Tumors as Collected in Central Cancer Registries Starting with the 2018 Diagnosis Year[a].

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) Vogelbaum MA, Hu C et al. (2015) van den Bent MJ, Brandes AA et al. (2013) The Cancer Genome Atlas Research Network, Brat DJ et al. (2015) Ceccarelli M, Barthel FP et al. (2016)	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) The Cancer Genome Atlas Research Network, Brat DJ et al. (2015) Ceccarelli M, Barthel FP et al. (2016)	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) Wiestler B, Capper D et al. (2013) The Cancer Genome Atlas Research Network, Brat DJ et al. (2015)	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) Stupp R, Hegi ME et al. (2007) Hegi ME, Liu L et al. (2008)	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)	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) Ceccarelli M, Barthel FP et al. (2016)	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) Eckel-Passow JE, Lachance DH et al. (2015) Ceccarelli M, Barthel FP et al. (2016)	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)	No
Medulloblastoma	Wingless (WNT) subtype	Low prevalence of metastatic disease (~5-10%) Highest five-year survival (~95%)	Kool M, Korshunov A et al. (2012) Northcott PA, Dubuc AM et al. (2012) Northcott PA, Jones DT et al. (2012) Northcott PA, Buchhalter I et al. (2017)	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) Northcott PA, Dubuc AM et al. (2012) Northcott PA, Jones DT et al. (2012) Northcott PA, Buchhalter I et al. (2017)	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) Northcott PA, Dubuc AM et al. (2012) Northcott PA, Jones DT et al. (2012) Northcott PA, Buchhalter I et al. (2017)	Yes Began in collection year 2018 (January 1), http://datadictionary.naaccr.org/default.aspx?c=10#3816
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) Northcott PA, Dubuc AM et al. (2012) Northcott PA, Jones DT et al. (2012) Northcott PA, Buchhalter I et al. (2017)	Yes Began in collection year 2018 (January 1), http://datadictionary.naaccr.org/default.aspx?c=10#3816

Table 24. Continued

Histology	Gene or Marker	Outcome	Related scientific publications	Collected by US Cancer Registry System
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) Korshunov A, Sturm D et al. (2014)	Yes Began in collection year 2018 (January 1), http://datadictionary.naaccr.org/default.aspx?c=10#3816

a. Available to CBTRUS for the first time in 2021.

Arita, H., Y. Narita, S. Fukushima, 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. PMID: 23764841. DOI: 10.1007/s00401-013-1141-6.

Cairncross, J. G., K. Ueki, M. C. Zlatescu, et al. Specific genetic predictors of chemotherapeutic response and survival in patients with anaplastic oligodendrogliomas. *J. Natl Cancer Inst.* 1998;90(19):1473-1479. PMID: 9776413.

Ceccarelli, M., F. P. Barthel, T. M. Malta, et al. Molecular Profiling Reveals Biologically Discrete Subsets and Pathways of Progression in Diffuse Glioma. *Cell.* 2016;164(3):550-563. PMID: 26824661. PMCID: 4754110. DOI: 10.1016/j.cell.2015.12.028.

Ceccom, J., F. Bourdeaut, N. Loukh, et al. Embryonal tumor with multilayered rosettes: diagnostic tools update and review of the literature. *Clin. Neuropathol.* 2014;33(1):15-22. PMID: 23863344. DOI: 10.5414/np300636.

Eckel-Passow, J. E., D. H. Lachance, A. M. Molinaro, et al. Glioma Groups Based on 1p/19q, IDH, and TERT Promoter Mutations in Tumors. *N. Engl. J. Med.* 2015;372(26):2499-2508. PMID: 26061753. PMCID: 4489704. DOI: 10.1056/NEJMoa1407279.

Hawkins, C., E. Walker, N. Mohamed, et al. BRAF-KIAA1549 fusion predicts better clinical outcome in pediatric low-grade astrocytoma. *Clin. Cancer Res.* 2011;17(14):4790-4798. PMID: 21610142. DOI: 10.1158/1078-0432.ccr-11-0034.

Hegi, M. E., A. C. Diserens, T. Gorlia, et al. MGMT gene silencing and benefit from temozolomide in glioblastoma. *N. Engl. J. Med.* 2005;352(10):997-1003. PMID: 15758010. DOI: 10.1056/NEJMoa043331.

Hegi, M. E., L. Liu, J. G. Herman, 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. PMID: 18757334. DOI: 10.1200/JCO.2007.11.5964.

Jiao, Y., P. J. Killela, Z. J. Reitman, et al. Frequent ATRX, CIC, FUBP1 and IDH1 mutations refine the classification of malignant gliomas. *Oncotarget.* 2012;3(7):709-722. PMID: 22869205. PMCID: PMC3443254. DOI: 10.18632/oncotarget.588.

Kool, M., A. Korshunov, M. Remke, 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. PMID: 22358457. PMCID: 3306778. DOI: 10.1007/s00401-012-0958-8.

Korshunov, A., D. Sturm, M. Ryzhova, 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. PMID: 24337497. DOI: 10.1007/s00401-013-1228-0.

Maire, C. L. and K. L. Ligon. Molecular pathologic diagnosis of epidermal growth factor receptor. *Neuro. Oncol.* 2014;16 Suppl 8:viii1-6. PMID: 25342599. PMCID: PMC4207139. DOI: 10.1093/neuonc/nou294.

Northcott, P. A., I. Buchhalter, A. S. Morrissy, et al. The whole-genome landscape of medulloblastoma subtypes. *Nature.* 2017;547(7663):311-317. PMID: 28726821. PMCID: PMC5905700. DOI: 10.1038/nature22973.

Northcott, P. A., A. M. Dubuc, S. Pfister, et al. Molecular subgroups of medulloblastoma. *Expert Rev. Neurother.* 2012;12(7):871-884. PMID: 22853794. PMCID: 4334443. DOI: 10.1586/ern.12.66.

Northcott, P. A., D. T. Jones, M. Kool, et al. Medulloblastomics: the end of the beginning. *Nat. Rev. Cancer.* 2012;12(12):818-834. PMID: 23175120. PMCID: 3889646. DOI: 10.1038/nrc3410.

Noushmehr, H., D. J. Weisenberger, K. Diefes, et al. Identification of a CpG island methylator phenotype that defines a distinct subgroup of glioma. *Cancer Cell.* 2010;17(5):510-522. PMID: 20399149. PMCID: 2872684. DOI: 10.1016/j.ccr.2010.03.017.

Stupp, R., M. E. Hegi, M. R. Gilbert, et al. Chemoradiotherapy in malignant glioma: standard of care and future directions. *J. Clin. Oncol.* 2007;25(26):4127-4136. PMID: 17827463. DOI: 10.1200/JCO.2007.11.8554.

The Cancer Genome Atlas Research Network, D. J. Brat, R. G. Verhaak, et al. Comprehensive, Integrative Genomic Analysis of Diffuse Lower-Grade Gliomas. *N. Engl. J. Med.* 2015;372(26):2481-2498. PMID: 26061751. PMCID: 4530011. DOI: 10.1056/NEJMoa1402121.

van den Bent, M. J., A. A. Brandes, M. J. Taphoorn, 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. PMID: 23071237. DOI: 10.1200/JCO.2012.43.2229.

Vogelbaum, M. A., C. Hu, D. M. Peereboom, et al. Phase II trial of pre-irradiation and concurrent temozolomide in patients with newly diagnosed anaplastic oligodendrogliomas and mixed anaplastic oligoastrocytomas: long term results of RTOG BR0131. *J. Neuro-Oncol.* 2015;124(3):413-420. PMID: 26088460. PMCID: 4584176. DOI: 10.1007/s11060-015-1845-7.

Wiestler, B., D. Capper, T. Holland-Letz, 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. PMID: 23904111. DOI: 10.1007/s00401-013-1156-z.

Yan, H., D. W. Parsons, G. Jin, et al. IDH1 and IDH2 mutations in gliomas. *N. Engl. J. Med.* 2009;360(8):765-773. PMID: 19228619. PMCID: 2820383. DOI: 10.1056/NEJMoa0808710.