Long-Term Trend of Central Nervous System Tumors in Nevada: 1974-2011

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Purpose

The primary purpose of this report is to describe the long-term trends of central nervous system (CNS) tumors in the State of Nevada and its counties, and to observe the impact of the changes in reporting and data analysis performed by the Brain Tumor Working Group (BTWG) and the National Program of Cancer Registries (NPCR), as well as the development and implementation of the Nevada Central Cancer Registry (NCCR). It is our intention that the report findings will be utilized by researchers, advisory boards, and public health professionals to facilitate the understanding of CNS long-terms trends and formulate valid interpretation of CNS tumors occurrence in Nevada.

Summary

This report assessed reported central nervous system (CNS) tumors from 1974 to 2011. However, after analysis of specific types of CNS tumors, trends were assessed in three separate periods: 1974-1988, 1989-2003, and 2004-2011. These dates correspond to milestones that affected CNS tumor reporting to the Nevada Central Cancer Registry (NCCR): when the NCCR began collecting CNS tumor data (1974); Brain Tumor Working Group (BTWG) recommendation to report non-malignant CNS tumors (1989); and Public Law 107-260 required the reporting of non-malignant brain and CNS tumors (2004).

Brain tumors are the most frequent type of malignant CNS tumors (>60%). Brain tumors have a stable incidence trend from 1978 to 2011 with a cumulative age-adjusted rate of 5.6 cases per 100,000 standard population. In terms of age, older populations, aged 24-74, were more affected by malignant brain tumors than younger populations, aged 0-24. Cumulative age-adjusted rates for older and younger populations were 6.8 and 1.6 cases per 100,000 standard population, respectively.

All other malignant CNS tumors were infrequent with age-adjusted annual rates of zero or unreliable and a cumulative age-adjusted rate from 1995 to 2011 of 0.8 cases per 100,000 standard population.

As expected, non-malignant CNS tumors were only largely reported since 2004 with the implementation of the Benign Brain Tumor Cancer Registries Amendment Act (Public Law 107-260). From 2004 to 2011, non-malignant CNS tumors accounted for 59.7% of all reported CNS tumors and had a cumulative age-adjusted rate of 16.3 cases per 100,000 standard population.

In Nevada, the cumulative age-adjusted rate of malignant CNS tumors from 1974 to 2011 was 6.4 cases per 100,000 standard population. Understandably, due to the relatively large proportion of the state population in Clark County and Washoe County, their CNS tumor cumulative age-adjusted rates are similar to those found in Nevada, 6.3 and 6.7 cases per 100,000 standard population. Most rural and frontier counties had unreliable or no incidence of CNS tumors during the observed period. For the years not suppressed, the small peaks of reported cancers do not fulfill the definition of cancer clusters[1].

After adjustment, some uncertainty in computed cancer rates may persists because many factors contribute to the incidence rate in a given year or location, and some factors exhibit random behavior. Chance plays a role in determining if and when cancer develops in an individual and whether that cancer is detected. For these reasons, the reported rates are expected to vary from year to year within a state or county even in the absence of a general trend. Thus, caution is warranted when examining cancer rates for a single year and more so when rates are based on relatively few cases.

Introduction

The nervous system is the control system of the body, performing many activities that include: sensory, integrative, and motor functions. It is able to sense external stimuli, interpret changes, and respond by muscular contraction or glandular secretion. The nervous system and endocrine system maintain balance within the body. It is essential to recognize the central nervous system (CNS) as an environment of special vulnerability, since the presence of tumors in the CNS are linked to special and emotional thoughts for their negative effect on a vital organ, whose meaning for patients' families and physicians are especially devastating. However, these pessimistic views are largely shifting. In fact, approximately 50% of patients with tumors of the CNS can be successfully treated and can enjoy an excellent long-term prognosis[2,3].

Brain tumors are classified on the basis of both cellular origin and site of the CNS. Neurons do not have significant reproductive capabilities and are therefore rarely the cellular origin of tumors. Glial (glue) cells have marked propensity for neoplastic transformation, and are the cellular substrate for almost half of all primary tumors. The remaining type of CNS tumors originate from a variety of other CNS supporting elements, such as meninges, choroid plexus, nerve sheath, and blood vessels. Due to the abnormal persistence of embryonic cells in the mature brain or to germinal mal migration, various primitive neoplasms form in the CNS. Another type of CNS primary tumor is the Primary CNS Lymphoma (in the absence of systemic lymphoma). By site, CNS tumors depend on the level of neuroaxis involvement: brain tumors, brain stem tumors, or intraspinal tumors. A secondary classification, by the presence or not of the spread of cancer cells from another initial site of disease to the CNS, the tumor is primary or metastatic to the CNS[3].

For CNS tumors, malignant or benign qualifiers are not as absolute as in other organ tumors, they are only relative distinctions. Brain tumors whether benign or malignant, produce similar damage in terms of mass effect. If a benign CNS tumor is situated on an ineradicable or a life related site in the CNS, its prognosis will be as lethal as a histologically malignant tumor found on the same site[4,5].

Influence of National/State Cancer Registries and their Data Standards

"Data collection of Primary CNS Tumors was created from the National Program of Cancer Registries (NPCR) to collect complete, standardized, and timely data over CNS tumor for its use in epidemiology, research, and efforts to improve treatment and quality of life for individuals with CNS tumors"[4].

In the United States, many cancer registries have collected data on CNS tumors. During the past 20 years, NPCR has strengthened the reporting of many types of cancer, created new registries, and improved the quality of data. The Nevada Central Cancer Registry (NCCR) began the collection of CNS cancer data in the 1970s; however, irregular data was reported prior to receiving funding from NPCR in 1995.

Nationally, before 1988, only malignant CNS Tumors were reportable to cancer registries. Later, the National Coordinating Council for Cancer Surveillance (NCCCS) established the Brain Tumor Working Group (BTWG) who summited their first report and recommendations in 1988. Their report included the addition of non-malignant CNS tumors to the data collection of malignant CNS tumors while utilizing a standard site and histology definition for tabulating estimates over these tumors in order to allow comparability of data across registries[5].

In 2002, President Bush signed the Public Law 107-260, the "Benign Brain Tumor Cancer Registries Amendment Act", making reporting of malignant and non-malignant CNS tumors to cancer registries mandatory[5]. Once implemented, all cancer registry standard setters required reporting of non-malignant brain and CNS tumors cases diagnosed on or after January 1, 2004.

Current Definition of CNS Reportable Cases

"Primary tumors (whether malignant or benign) listed in the International Classification of Diseases for Oncology (ICD-O-3), occur in the following sites: (I) the brain, meninges, spinal cord, cauda equine, a cranial nerve or nerves, or any other part of the central nervous system, (II) the pituitary gland, pineal gland, or craniopharyngeal duct"[5].

Epidemiology of CNS Tumors

Primary CNS tumors are uncommon; accounting for 1-2% of all cancers worldwide each year[3], 1.39% in the nation in 2010[6], and 1.4% of all tumors in Nevada (being the 15th cause of cancer in the 25 leading causes of cancer list) for 2011, of which 8.5% were among children less than 20 years of age, and 91.5% in the adult ages (20+ years of age)[7]. Under the Childhood International Classification of Cancer (utilized for the cases less than 20 years of age), CNS tumors are the 3rd largest cause of cancer in the nation, accounting for 18.9% in 2006-2010[6]; and the 3rd largest cause of cancer in Nevada, accounting for 9.4% of all childhood cancer in 2006-2010[8]. Typically affecting the elderly, primary central nervous system lymphomas (PCNSL) were generally considered rare, accounting for 1-2% of all intracranial tumors. During the last 20 years, there has been a dramatic rise in the incidence of PCNSL partly due to its frequent occurrence in immuno-deficient states, (e.g. AIDS, transplant recipients). Although PCNSL experienced an increase, its occurrence in immune competent individuals is still unexplained.

Methods

CNS Tumors counts, and information on county at diagnosis, age at diagnosis, and year of diagnosis, were obtained from the 04/29/2014 Nevada Central Cancer Registry data extract[7]. Age-adjusted Rates, and Confidence Limits were calculated with SEER*Stat methodology[2]. Relative Standard Error (RSE) were calculated for all age-adjusted rates[9, 10, 11, 12].

Annual age-adjusted rates between 1974 and 2011 were calculated for all the CNS cases included in the group (I) of the case definition, including Primary Central Nervous Lymphomas, by year, by county and by region, and denominator populations were from the US census[9, 10, 11, 12].

The state level trends analysis was performed first by All CNS tumors, followed by annual rates charts including only malignant tumors. Only malignant tumors were further classified as malignant brain tumors and all other except brain CNS malignant tumors. Charts for annual counts and rates from 1974-2011 were developed.

Geographical description was included by county and by describing three geo-demographical regions: Urban-high populated counties such as Clark County and Washoe County, and All Other counties, (which include Rural and Frontier, low and very low population density counties).

Technical Notes

The incidence rate is the basic measure of disease occurrence as it expresses the probability or risk of disease in a defined population over a specific period of time. Age-adjusted rates with a common standard population allow comparisons of rates between different regions with different age structures. Annual age-adjusted rates were calculated utilizing the national standard: Year 2000 US Standard Population (19 Age-groups), which were expressed per 100,000 Standard Population.

The accuracy of age-adjusted incidence rates are reflected by the Relative Standard Error (RSE). RSE is the measure of the extent of the age-adjusted rate is likely to deviate from the true population, expressed as a fraction of the age-adjusted estimate, and is usually displayed as a percent. A RSE of magnitude ≥30% is considered statistically unreliable for this report and a "¥" symbol is displayed in place of the corresponding rate.

The reliability of the age-adjusted rates was assessed in terms of confidence intervals. The confidence intervals for this report, are expected to contain the true underlying rate 95% of the time. Counts more than zero but less than or equal to 5 and their resulted rates and confidence limits, were removed due to confidentiality as well as reliability issues, a "¥" symbol is displayed in place of the corresponding rate and confidence intervals.

CNS tumors case definition for this report was the Group (I) in the current CNS case definition[5]. This includes ICD-O-3 Site codes C710-C719, all histologies except 9530-9539, 9590-9989, 9050-9055, 9140 and Site codes C700-C709, C720-C729, all histologies except 9590-9989, 9050-9055, 9140.

Results

State of Nevada

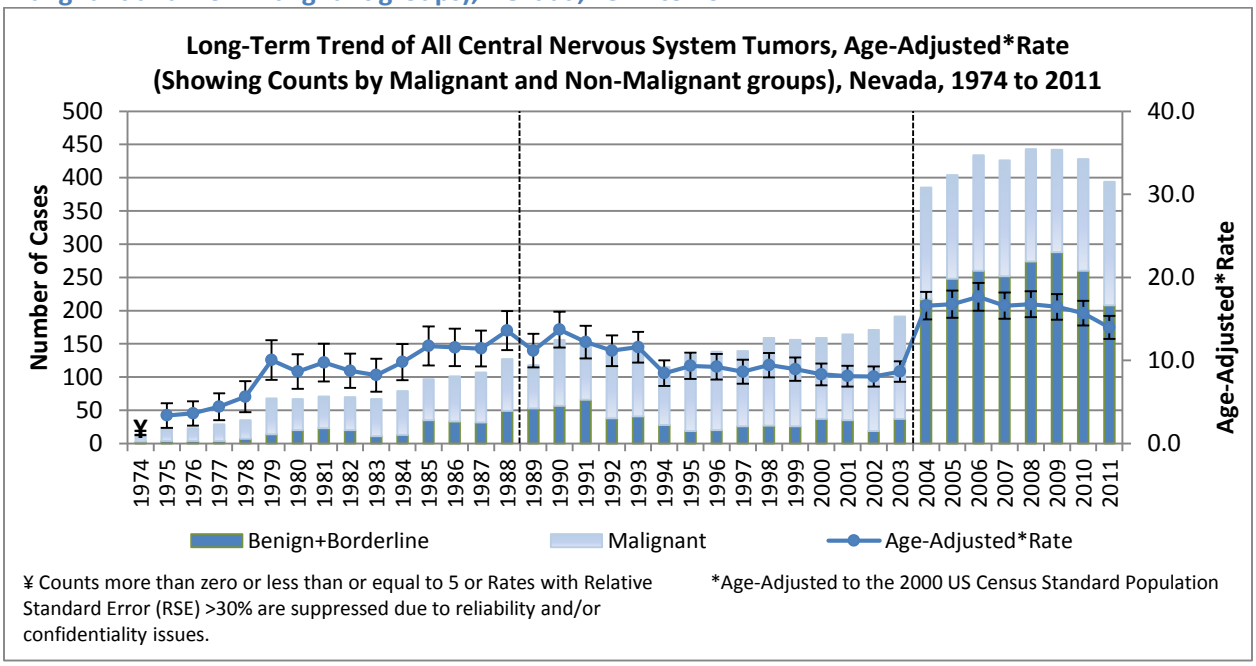
The Nevada 1974 to 2011 trends of all CNS tumors depict the clear impact of different reporting criterions and inappropriate general trend from 1974 to 2011. Three different time periods can be distinguished.

The first period, 1974 to 1988 (15 years), from the start of CNS reporting to the state registry to the publishing of the BTWG recommendations to add non-malignant cases to the list of reportable cancers to cancer registries and the development of a standardized case-definition[5]. During this period, the case reporting to Nevada Central Cancer Registry (NCCR) was poor, but increased as a result of the NCCR operations. Some non-malignant cases were reported irregularly; producing irregular age-adjusted rates (between 3.4 to more than 13.6 cases per 100,000 population), with wide confidence limits, generating an unreliable increasing trend.

The second period, from 1989 to 2003 (15 years), from the time BTWG recommendations to the mandatory reporting of non-malignant tumors, were stable with annual age-adjusted rates of 9.5 cases per 100,000 population. Confidence limits were narrower and stable. During the three first years after the BTWG recommendation the non-malignant reporting percentage was above 35%. This was most likely due to the recommendation on hospital registries. However, non-malignant reporting fell to 17% and to 11% the following years. Rates for these years reflected these changes (age-adjusted rates from 8.1 to 13.7 cases per 100,000 population), but were stable after 1994 (age-adjusted 1994-2003 of 9.2 cases per 100,000 population).

The third period, 2004 to 2011 (8 years), after the reporting of non-malignant tumors became mandatory, showed an increase in age-adjusted rates. Compared to the previous period, age-adjusted rates almost double to 16.3 cases per 100,000 population. This growth was related to the increase in non-malignant tumors reporting. This resulted in an annual average non-malignant tumor reporting of 59.7%, higher than the BTWG report estimate of 50%[4]. Rates for this period were stable, and was the most current and complete representation of the CNS tumors occurrence in Nevada (Figure 1).

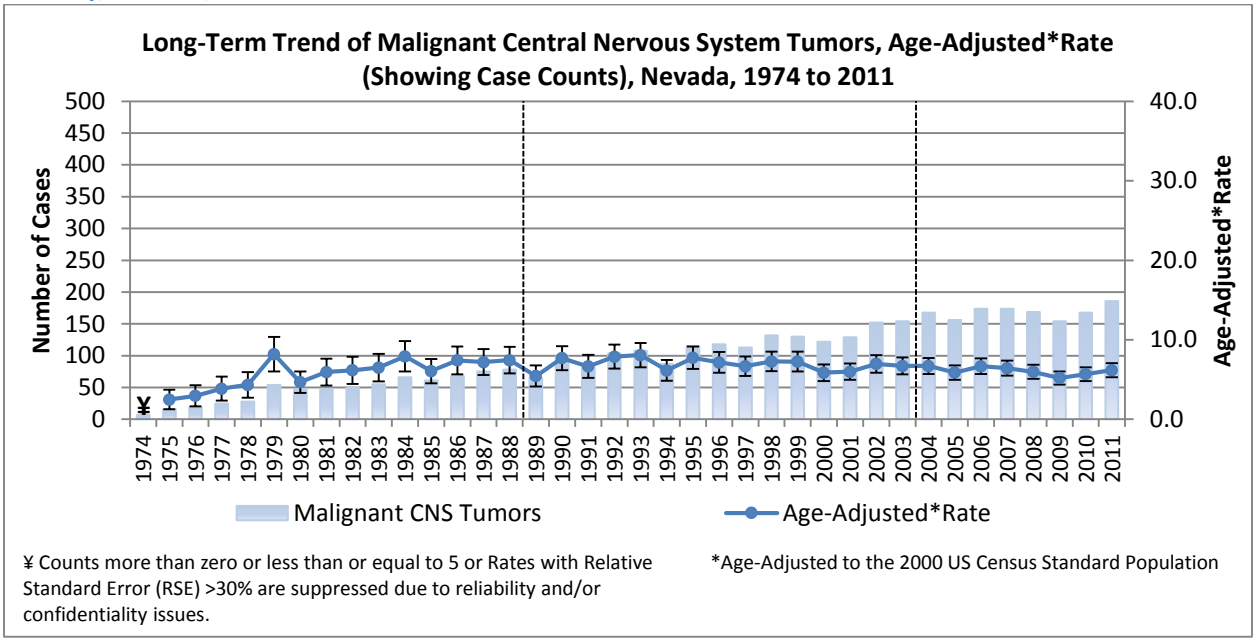
Figure 1: Long-Term Trend of All Central Nervous System Tumors, Age-Adjusted*Rate (Showing Counts by Malignant and Non-Malignant groups), Nevada, 1974 to 2011



¥ Counts more than zero or less than or equal to 5 or Rates with Relative Standard Error (RSE) >30% are suppressed due to reliability and/or confidentiality issues.

*Age-Adjusted to the 2000 US Census Standard Population

Figure 2: Long-Term Trend of Malignant Central Nervous System Tumors, Age-Adjusted*Rate (Showing Case Counts), Nevada, 1974 to 2011



Malignant CNS tumors rates were unreliable in 1974, followed by an increasing incidence trend during the first time period (1974-1988) with age-adjusted rates from 2.5 to 8.2 cases per 100,000 standard population. This increase is most likely due to the initial reporting to the NCCR. An increase in case reporting occurred in 1979, which coincides with when the NCCR initiated active operations statewide, when hospitals serving non-urban populations began reporting. From 1980 to 2011, rates show a stable and reliable general trend, with age-adjusted rate of 6.4 cases per 100,000 standard population (Figure 2).

Figure 3 shows that most malignant CNS tumors were brain tumors; thus malignant brain tumors and malignant CNS tumors had a similar trends and with very similar rates (age-adjusted 1980-2011 rate of 5.6 cases per 100,000 standard population).

Figure 3: Long-Term Trend of Malignant Brain Tumors, Age-Adjusted*Rate (Showing Case Counts), Nevada, 1974 to 2011

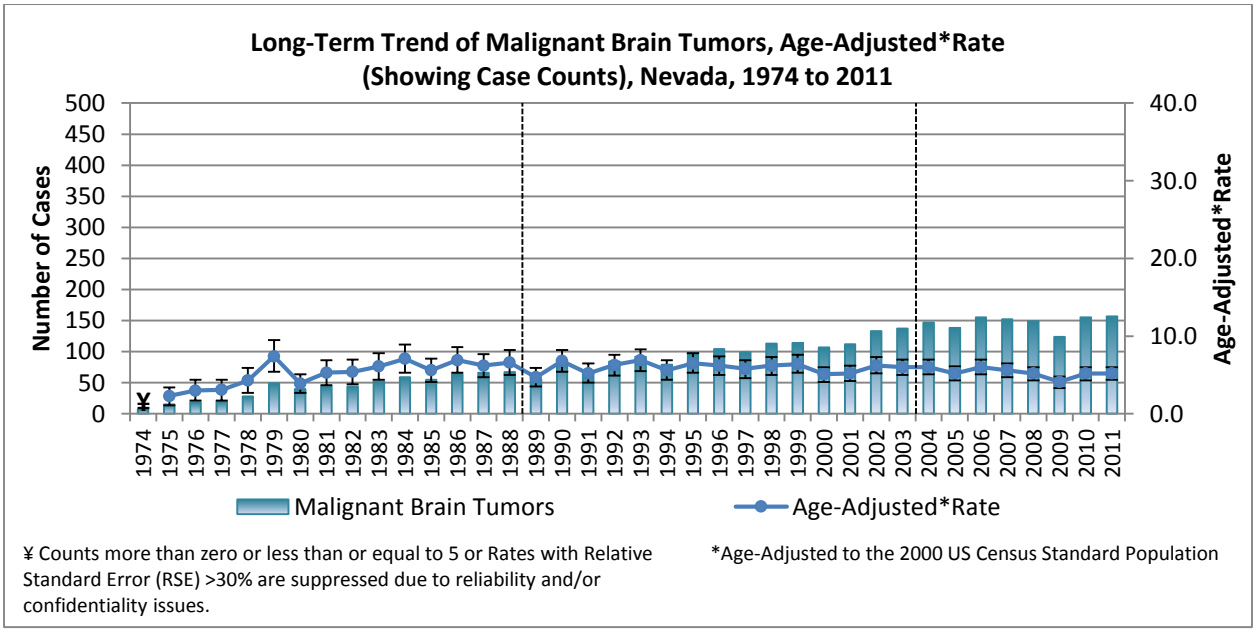
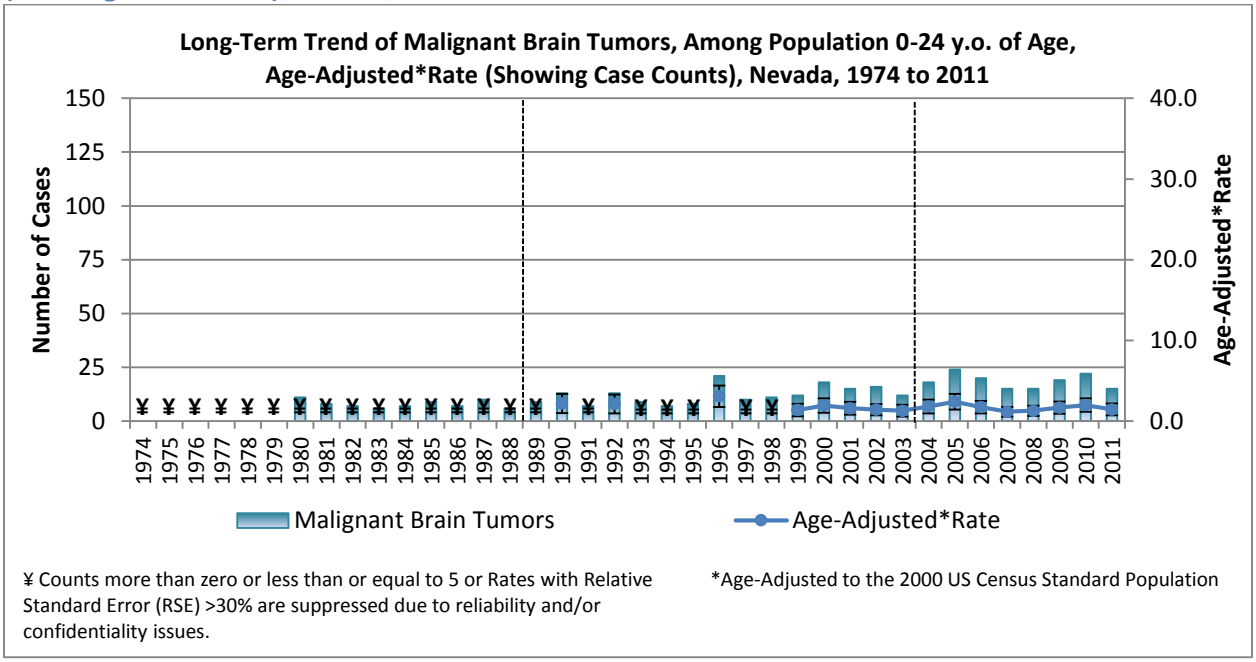


Figure 4: Long-Term Trend of Malignant Brain Tumors, Among Population 0-24 y.o. of Age, Age-Adjusted*Rate (Showing Case Counts), Nevada, 1974 to 2011



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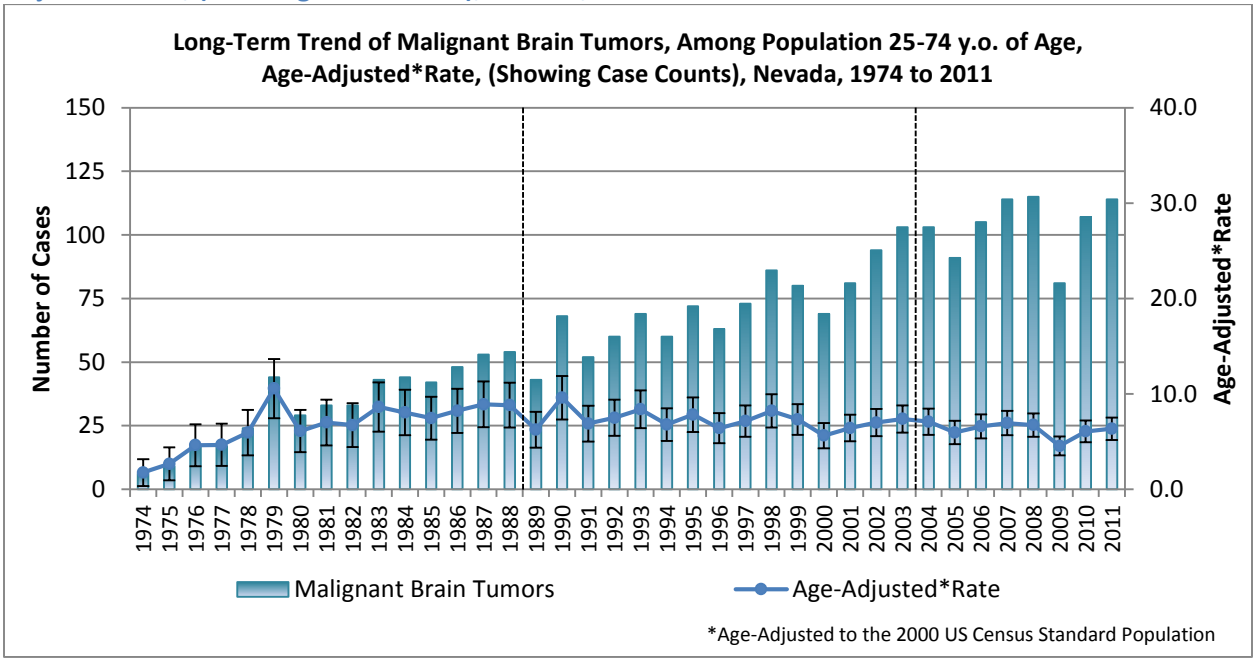
*Age-Adjusted to the 2000 US Census Standard Population

Majority of annual age-adjusted rates for malignant brain tumors in the 0-24 age-group prior to 1999 were unreliable due to the low frequency of reported cases. Since 1999, annual age-adjusted rates for this group were very small (between 1.4 and 2.4 cases per 100,000 standard population) with wide confidence limits. Careful interpretation is required for these years. Trend for this period was slightly declining (Figure 4).

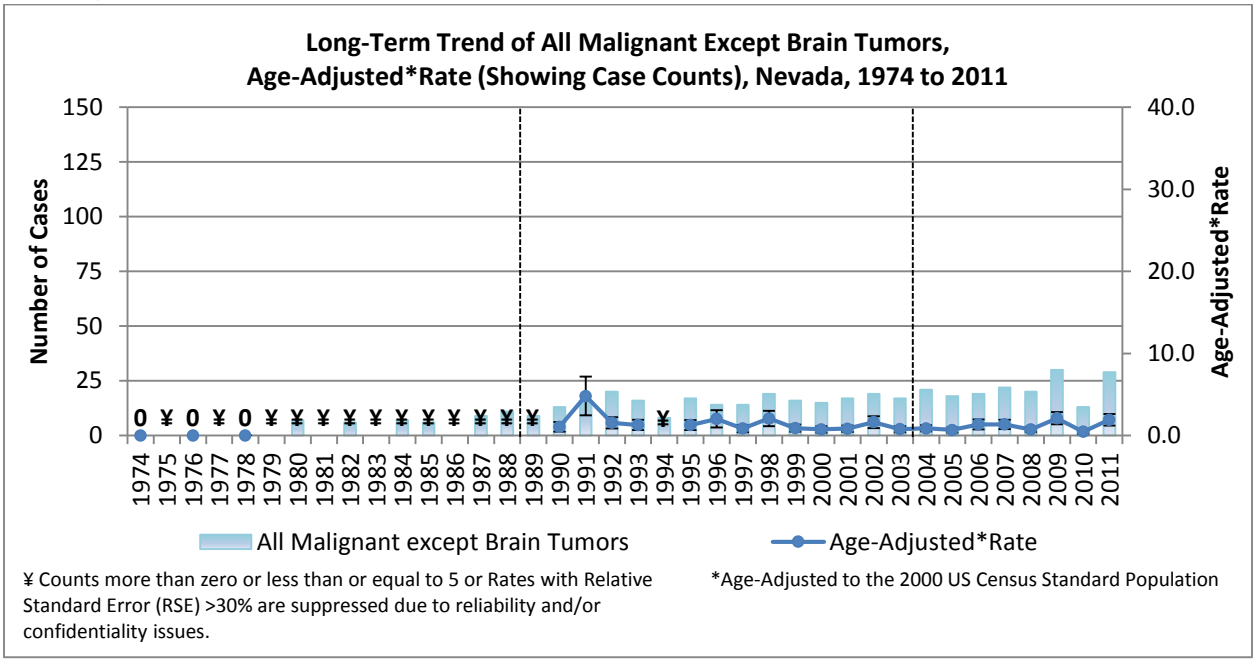
Annual reporting of malignant brain tumors in the 25-74 age-group were consistent after 1978, representing 70.4% of the reported cases, with cumulative age-adjusted rate of 7.3 cases per 100,000 standard population.

Figure 5: Long-Term Trend of Malignant Brain Tumors, Among Population 25-74 y.o. of Age, Age-Adjusted*Rate, (Showing Case Counts), Nevada, 1974 to 2011



*Age-Adjusted to the 2000 US Census Standard Population

Figure 6: Long-Term Trend of All Malignant Except Brain Tumors, Age-Adjusted*Rate (Showing Case Counts), Nevada, 1974 to 2011



The remaining types of malignant tumors, all malignant-except brain tumors, had unreliable or poor reporting until 1995. With the improvement of NCCR operations in the state after CDC funding in 1995, all malignant expect brain tumors had a stable trend between 1995 and 2011 with an age-adjusted rate of 0.8 cases per 100,000 standard population (Figure 6).

Trends by County

Nevada is one of the least population dense states in the nation with less than 25 people per square mile (the national overall index is 87.4). Nevada has a fairly polarized demographic distribution by county, with two main urban geographical areas accounting for 83.9% of Nevada's average population from 1974-2011, and the remaining 16.1% in 15 other counties. Of which, four counties have a population sizes between 25,000 and 50,000, and 11 counties with less than 25,000.

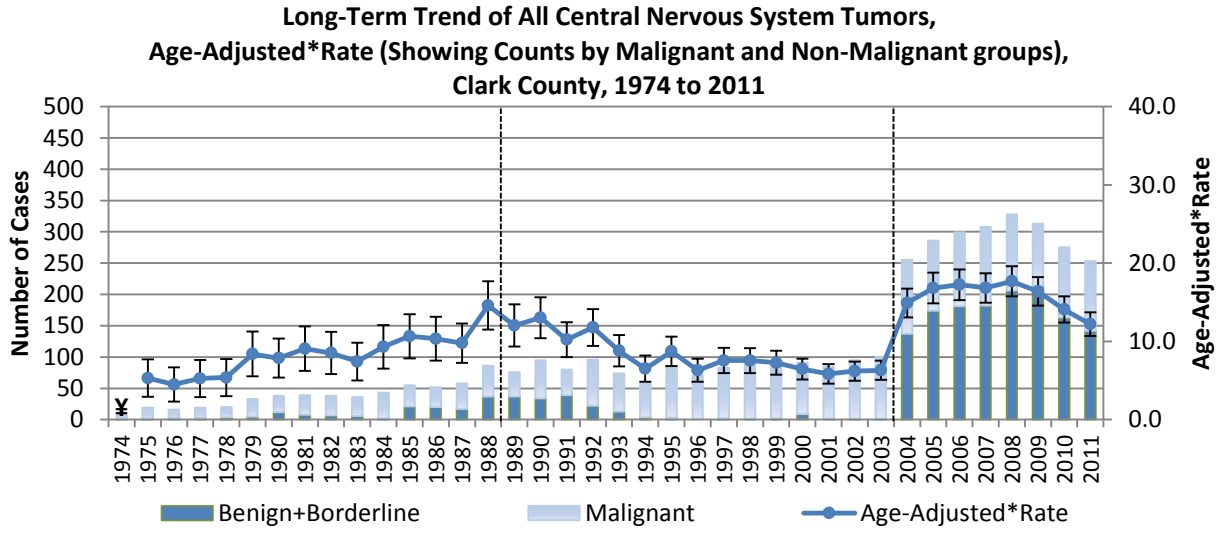
CNS Tumors county trends are presented with urban counties, followed by trends in counties with populations between 25,000 and 50,000, and counties with populations less than 25,000.

Since Clark County consists of 64.8% of Nevada's average population from 1974-2011, Clark County and Nevada have similar incidence trends. From 1974-1988, the age-adjusted rate was 8.7 cases per 100,000 standard population with wide confidence limits.

From 1989-2003, rates were slightly lower than the state, depicting the influence of irregular non-malignant case reporting. From 1989 to 1991 age-adjusted rates were high (10.2 to 13.0 cases per 100,000 standard population) with the majority from malignant tumor case reporting. There were few non-malignant cases reported during the remainder of the second period, and consequently decreasing rates were seen (age-adjusted rates of 6.3 to 11.8 cases per 100,000 standard population).

After 2004, non-malignant tumor reporting had a stable proportion (an annual average of 60%), similar to the rest of the state, which almost doubled rates compared to the second period (cumulative age-adjusted rate 2004-2011 was 15.7 cases per 100,000 standard population) (Figure 7).

Figure 7: Long-Term Trend of All Central Nervous System Tumors, Age-Adjusted*Rate (Showing Counts by Malignant and Non-Malignant groups), Clark County, 1974 to 2011



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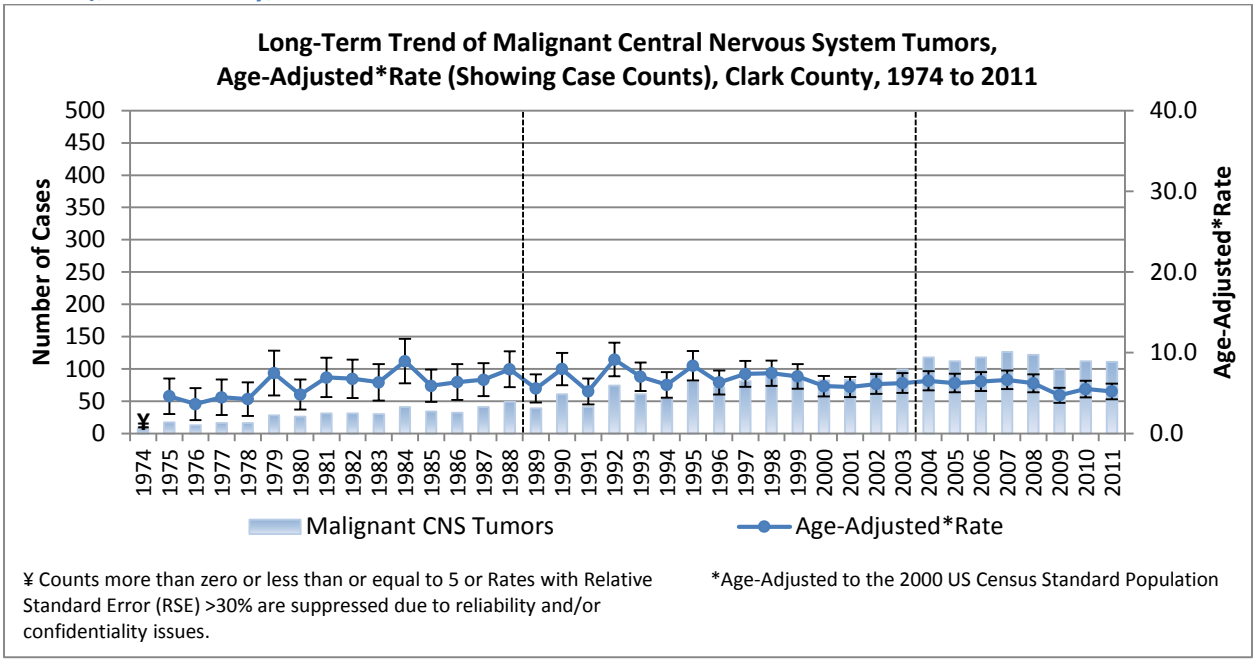
*Age-Adjusted to the 2000 US Census Standard Population

Figure 8: Long-Term Trend of Malignant Central Nervous System Tumors, Age-Adjusted*Rate (Showing Case Counts), Clark County, 1974 to 2011



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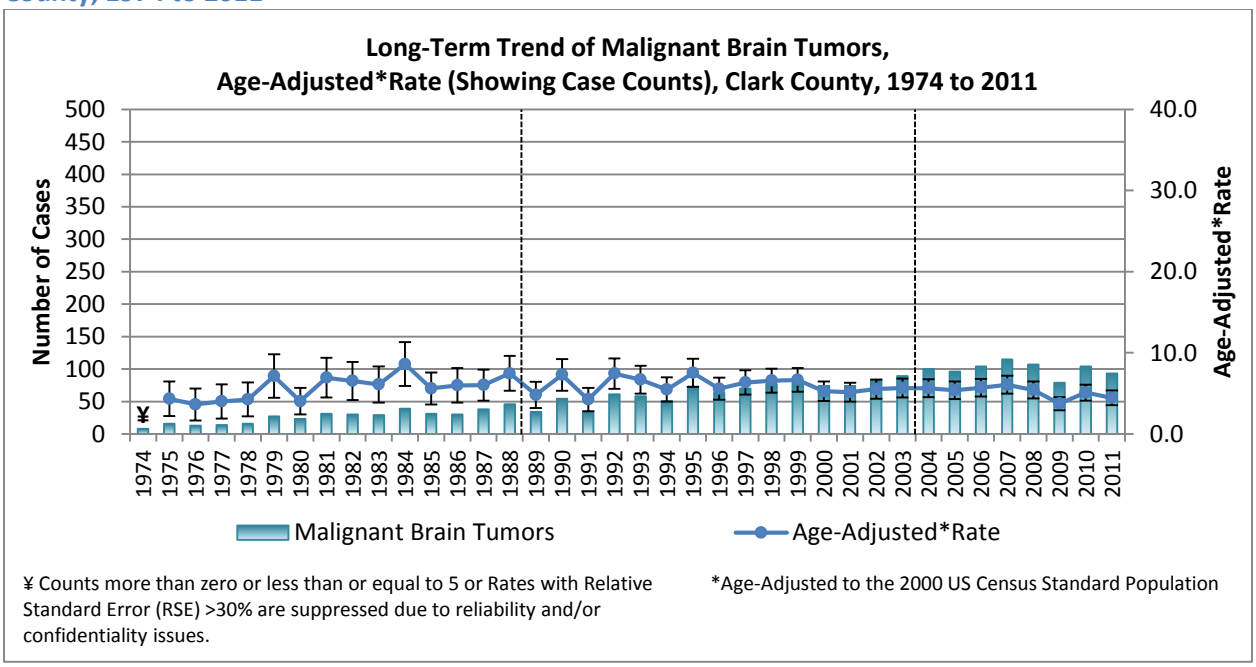
*Age-Adjusted to the 2000 US Census Standard Population

The malignant CNS tumor rates in Clark County and Nevada were similar with a stable trend after 1988 (age-adjusted rate 1988-2011 of 6.3 cases per 100,000 standard population). Malignant brain tumors in Clark County represented almost all cases of malignant CNS tumors, with a cumulative age-adjusted rate of 6.3 cases per 100,000 standard population. Rates slightly decreased after 2008 (age-adjusted rates of 4.7 to 6.2 cases per 100,000 standard population). Due to low case counts, age-adjusted annual rates for all other malignant tumors except brain were statistically unreliable and cannot be reported. Cumulative 1974-2011 age-adjusted rate was 0.7 cases per 100,000 standard population) (Figures 8 and 9).

Figure 9: Long-Term Trend of Malignant Brain Tumors, Age-Adjusted*Rate (Showing Case Counts), Clark County, 1974 to 2011



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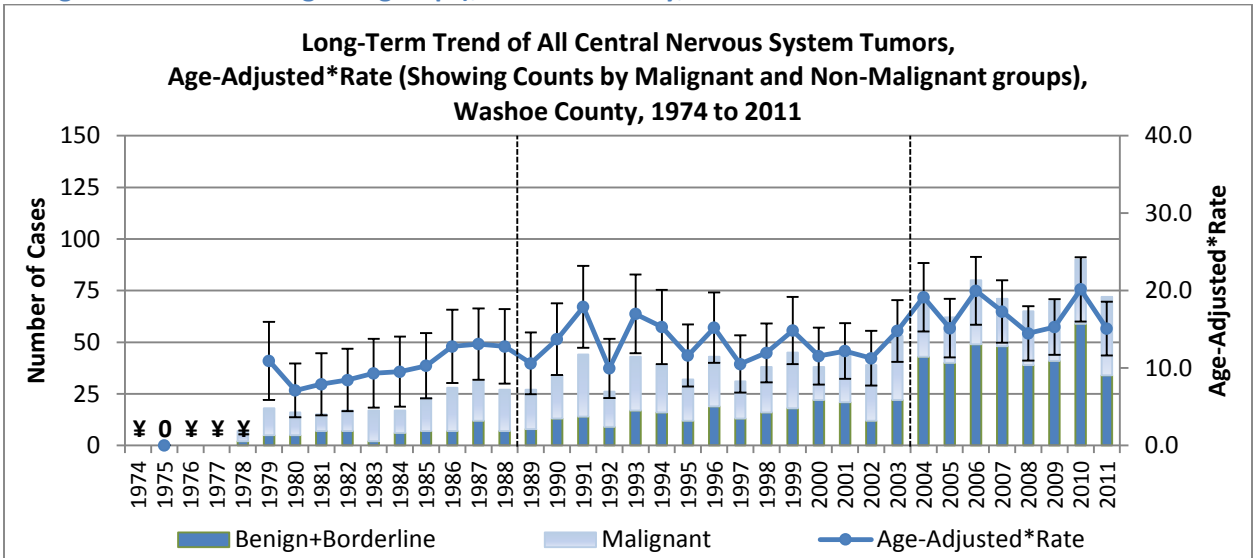
*Age-Adjusted to the 2000 US Census Standard Population

Figure 10: Long-Term Trend of All Central Nervous System Tumors, Age-Adjusted*Rate (Showing Counts by Malignant and Non-Malignant groups), Washoe County, 1974 to 2011

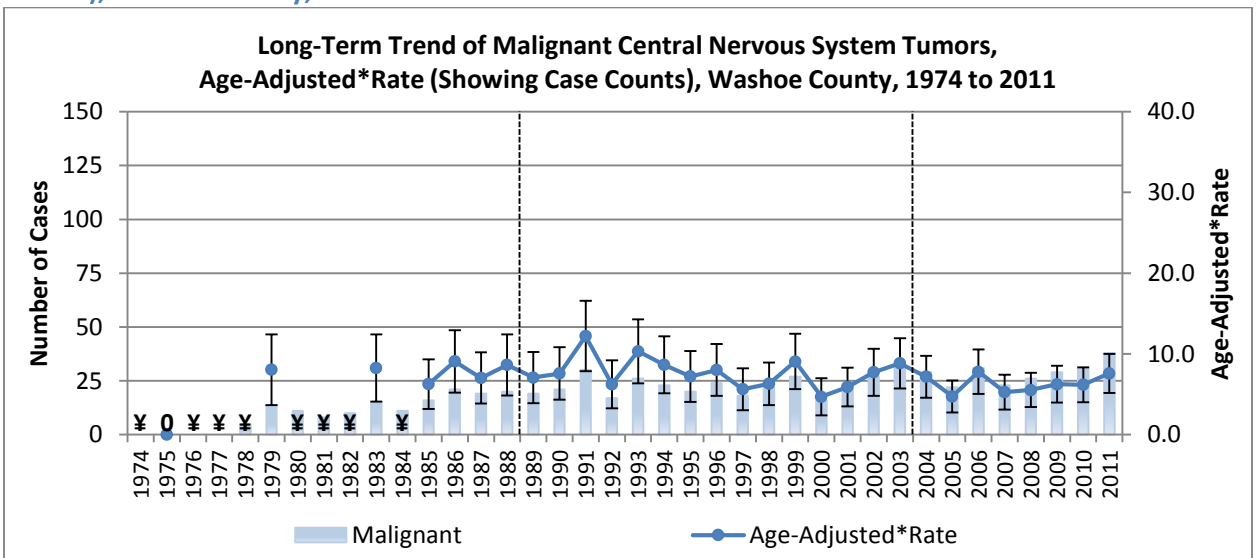


¥ Counts more than zero or less than or equal to 5 or Rates with Relative Standard Error (RSE) >30% are suppressed due to reliability and/or confidentiality issues.

*Age-Adjusted to the 2000 US Census Standard Population

Washoe County, the second most population dense county in Nevada, consisted of 19.1% of Nevada's average population from 1974-2011. Prior to 1979, rates for all CNS tumors were unreliable and were suppressed. After 1979, case reporting increased in association with the initial statewide operations in the NCCR. Rates were higher in Washoe County than Clark County and statewide with age-adjusted rates of 13.2 cases per 100,000 standard population between 1989 and 2003 and 17.0 cases per 100,000 standard population between 2004 and 2011. Caution is warranted during interpretation due to wide confidence intervals. With irregular reporting between 30% and 40% of all CNS tumors, Washoe County had greater non-malignant case reporting compared to the rest of the state from 1988 to 2003. This lead to higher rates during this period. Similar to Nevada and Clark County, after 2003, non-malignant reporting increased to 60% of all CNS tumor cases reported (Figure 10).

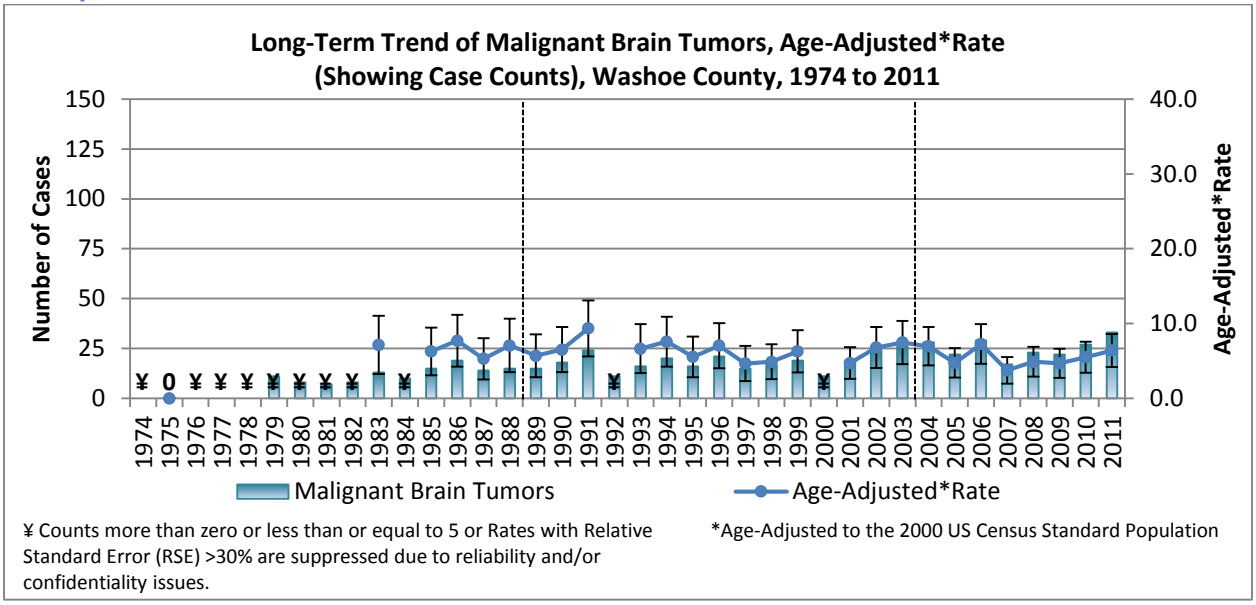
Figure 11: Long-Term Trend of Malignant Central Nervous System Tumors, Age-Adjusted*Rate (Showing Case Counts), Washoe County, 1974 to 2011



¥ Counts more than zero or less than or equal to 5 or Rates with Relative Standard Error (RSE) >30% are suppressed due to reliability and/or confidentiality issues.

*Age-Adjusted to the 2000 US Census Standard Population

Figure 12: Long-Term Trend of Malignant Brain Tumors, Age-Adjusted*Rate (Showing Case Counts), Washoe County, 1974 to 2011



Between 1979 and 2003, age-adjusted rates for malignant tumors in Washoe County were between 4.7 and 12.2 cases per 100,000 standard population (cumulative rate for the period was 7.6 cases per 100,000 standard population). Caution is warranted during interpretation due to wide confidence intervals. Rates were stable between 2004 and 2011, with a cumulative age-adjusted rate of 6.3 cases per 100,000 standard population. These rates were similar to the state and greater than rates in Clark County (Figure 11).

Although malignant brain tumors consisted of a large proportion of all malignant tumors in Washoe County, rates were unreliable for the majority of years prior to 1988. From 1988 to 2003, rates were irregular with unreliable rates and annual rates between 4.6 and 9.4 cases per 100,000 standard population (cumulative rate for the period was 6.0 cases per 100,000 standard population) with wide confidence limits. Similar to Clark County, trends were stable after 2003 with a cumulative age-adjusted rate of 5.5 cases per 100,000 standard population, (Figure 12). Due to low case counts, age-adjusted annual rates for all other malignant tumors except brain were statistically unreliable (Figure 13).

Figure 13: Long-Term Trend of All Malignant Except Brain Tumors, Age-Adjusted*Rate (Showing Case Counts), Washoe County, 1974 to 2011

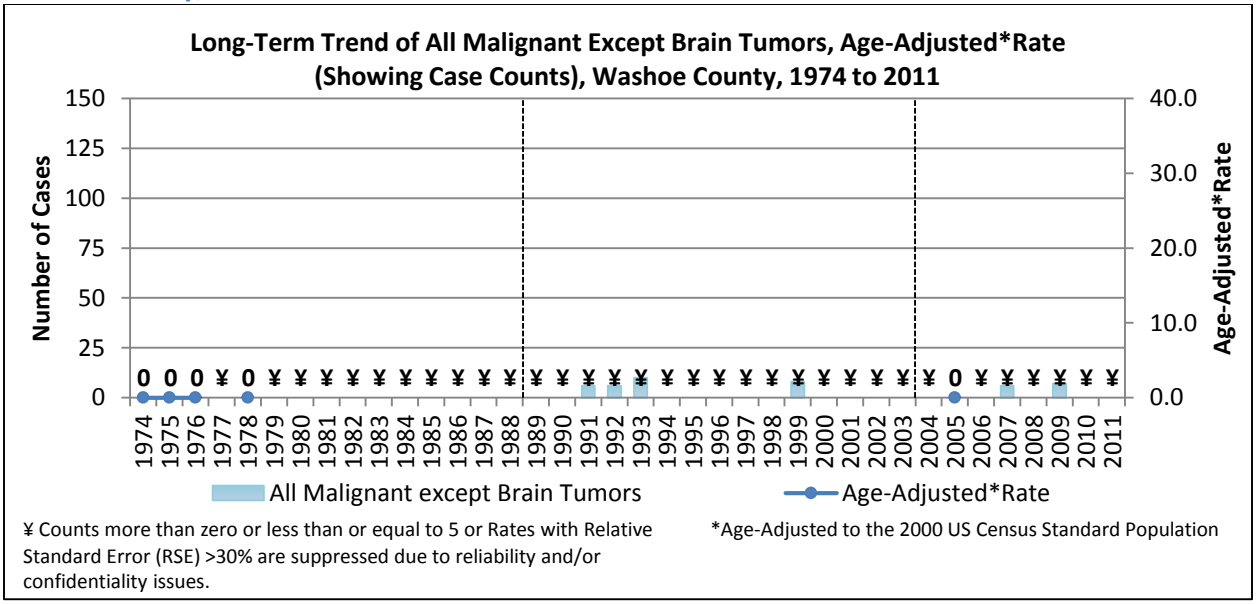
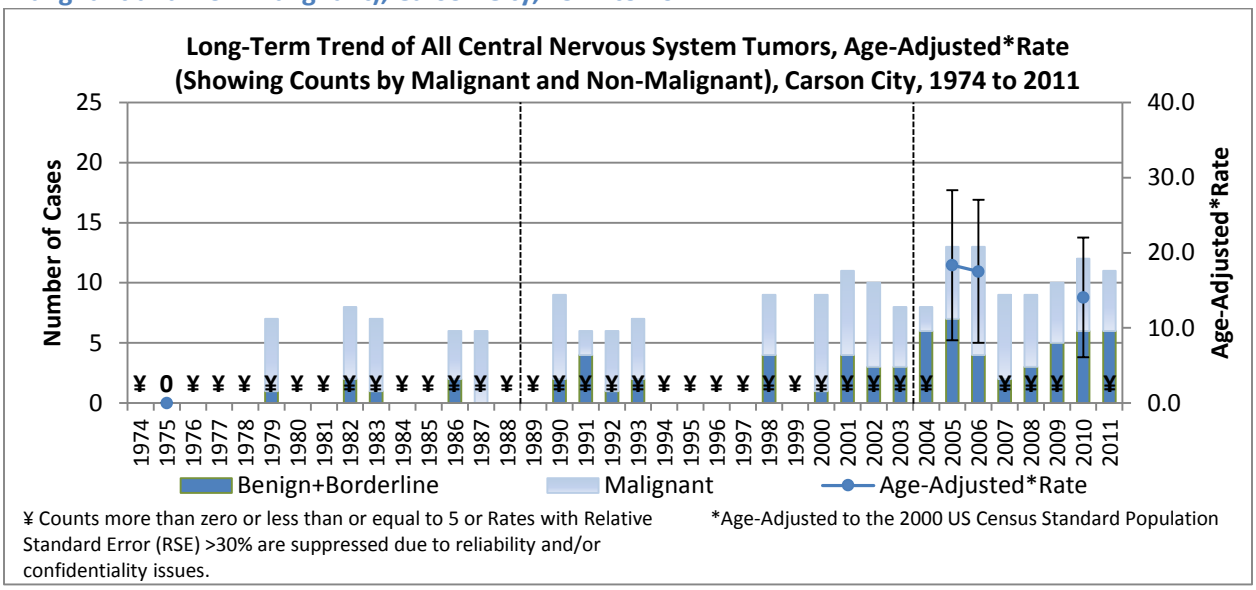


Figure 14: Long-Term Trend of All Central Nervous System Tumors, Age-Adjusted*Rate (Showing Counts by Malignant and Non-Malignant), Carson City, 1974 to 2011



Carson City, Elko, Douglas, and Lyon counties had populations between 25,000 and 50,000, which consisted of 9.7% of Nevada's average population from 1974-2011. Due to low case counts prior to 2005, all age-adjusted annual rates for all CNS tumors were statistically unreliable with zero or few cases reported each year. Similarly, irregular case reporting was present from 2004 to 2011. Reliable annual rates in Carson City ranged between 14.1 and 21.3 cases per 100,000 standard population. Caution is warranted during interpretation due to wide confidence intervals. Cumulative age-adjusted rates from 1974 to 1988, 1989 to 2003, and 2004 to 2011 were 12.9, 12.0, and 15.0 cases per 100,000 standard population, respectively (Figure 14).

Due to low case counts prior to 2006, all age-adjusted annual rates for all CNS tumors were statistically unreliable with zero or few cases reported each year in Lyon County. Reliable annual rates ranged between 19.7 and 25.4 cases per 100,000 standard population. Although higher than Nevada's, caution is warranted during interpretation due to wide confidence intervals. Cumulative age-adjusted rates from 1974 to 1988, 1989 to 2003, and 2004 to 2011 were 10.1, 12.0, and 19.4 cases per 100,000 standard population, respectively. High rates were primarily due to increased non-malignant tumor reporting. A trend was not definable (Figure 15).

Figure 15: Long-Term Trend of All Central Nervous System Tumors, Age-Adjusted*Rate (Showing Counts by Malignant and Non-Malignant groups), Lyon County, 1974 to 2011

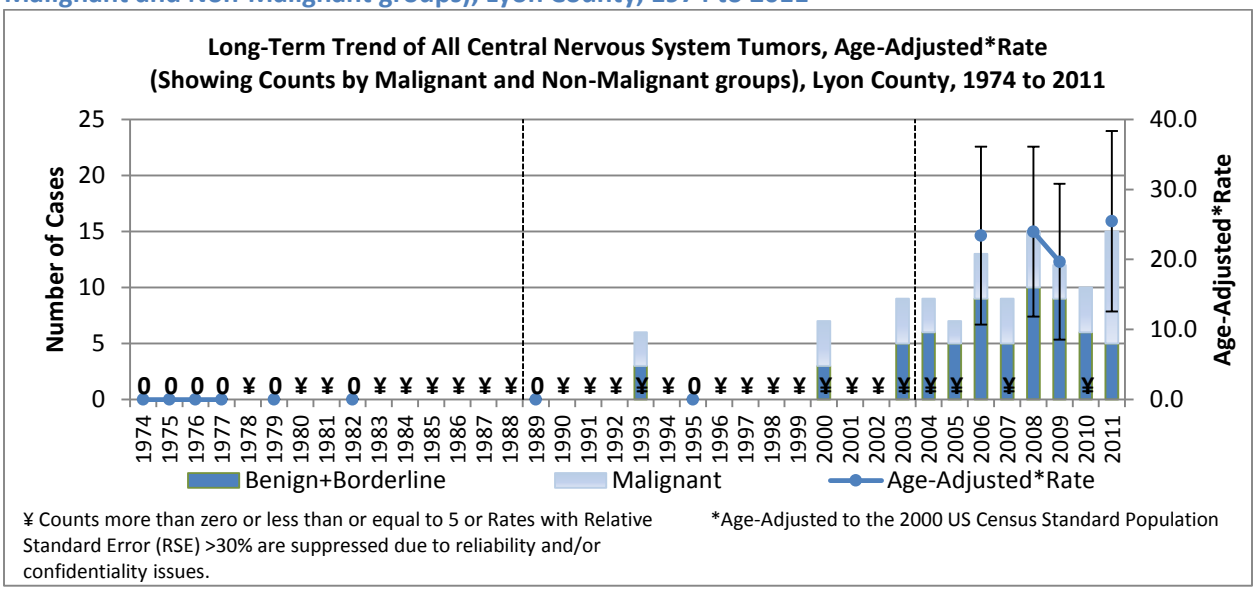
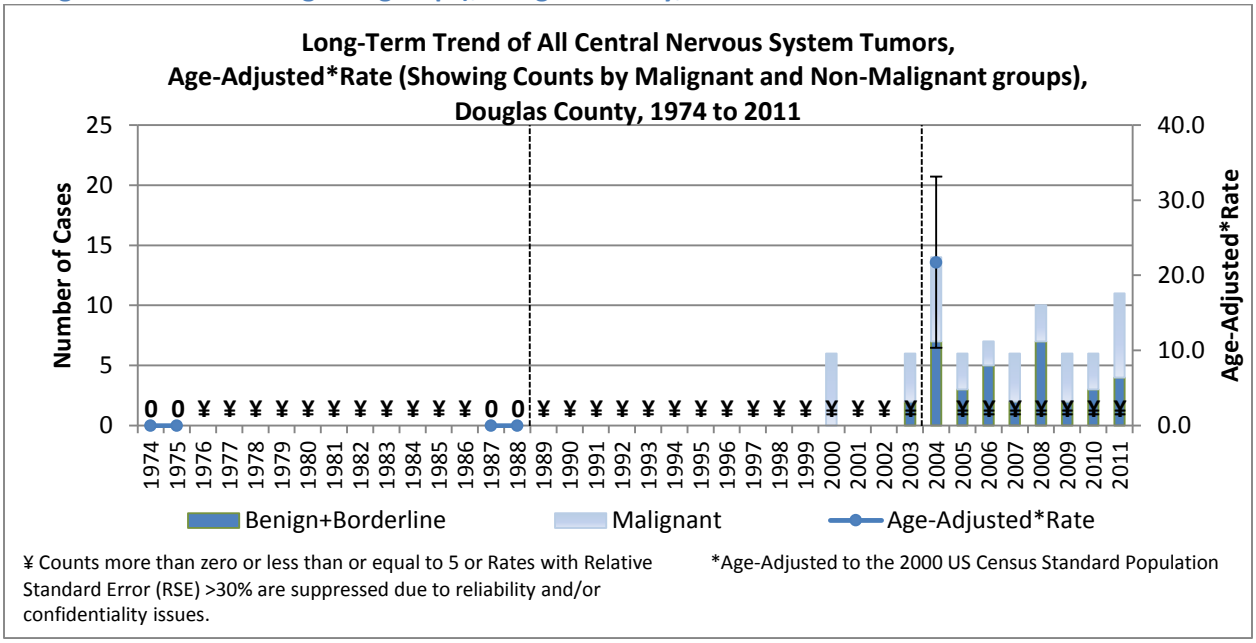


Figure 16: Long-Term Trend of All Central Nervous System Tumors, Age-Adjusted*Rate (Showing Counts by Malignant and Non-Malignant groups), Douglas County, 1974 to 2011



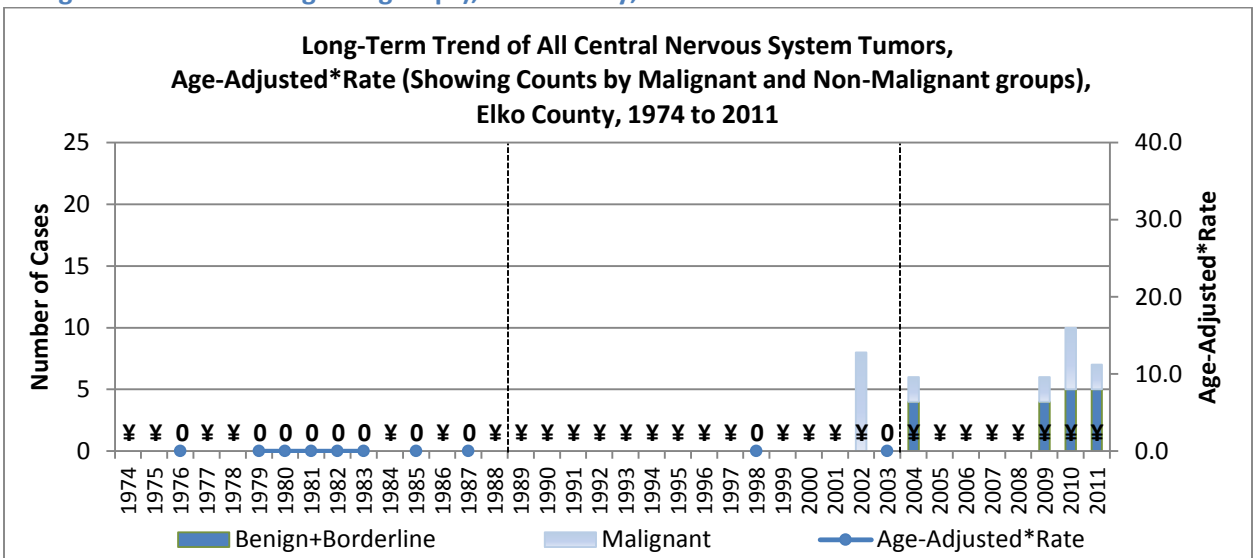
¥ Counts more than zero or less than or equal to 5 or Rates with Relative Standard Error (RSE) >30% are suppressed due to reliability and/or confidentiality issues.

*Age-Adjusted to the 2000 US Census Standard Population

Due to low case counts, most age-adjusted annual rates for all CNS tumors were statistically unreliable with zero or few cases reported each year in Douglas County, except in 2004 where the age-adjusted rate was 21.7 per 100,000 standard population. Caution is warranted during interpretation due to wide confidence intervals (Figure 16). Cumulative age-adjusted rates from 1974 to 1988, 1989 to 2003, and 2004 to 2011 were 5.5, 9.3, and 12.2 cases per 100,000 standard population, respectively.

Although with an average of 50.7% of non-malignant tumors, Elko County had statistically unreliable rates with zero or few cases reported each year due to low case counts (Figure 17). Cumulative age-adjusted rates from 1974 to 1988, 1989 to 2003, and 2004 to 2011 were unreliable, 7.1, and 13.9 cases per 100,000 standard population, respectively.

Figure 17: Long-Term Trend of All Central Nervous System Tumors, Age-Adjusted*Rate (Showing Counts by Malignant and Non-Malignant groups), Elko County, 1974 to 2011

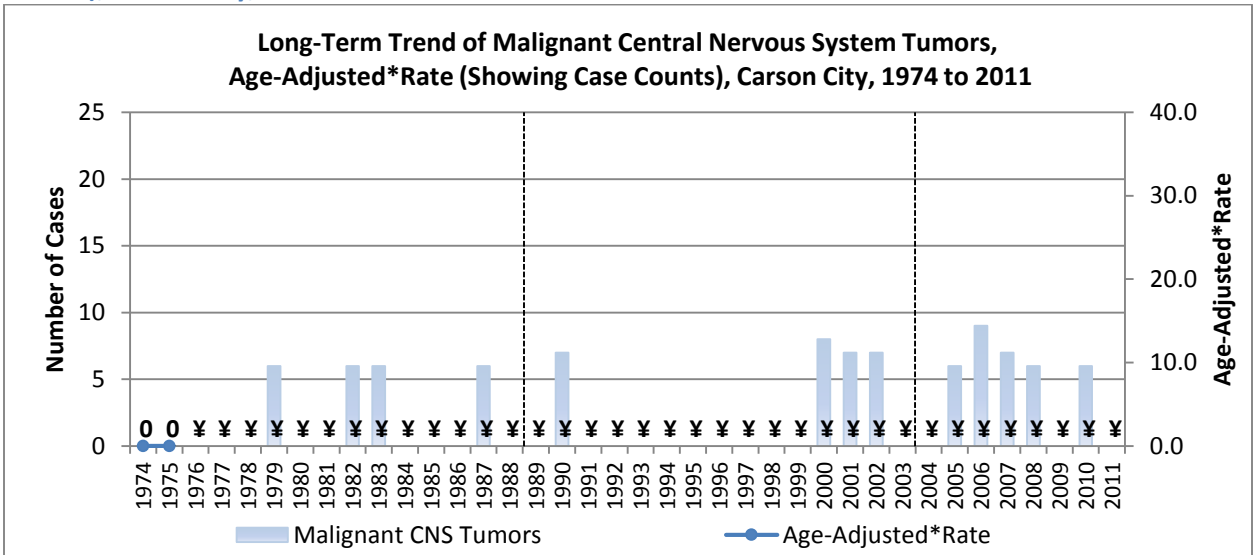


¥ Counts more than zero or less than or equal to 5 or Rates with Relative Standard Error (RSE) >30% are suppressed due to reliability and/or confidentiality issues.

*Age-Adjusted to the 2000 US Census Standard Population

Due to low case counts, age-adjusted annual rates for only malignant tumors were statistically unreliable for all observed years in all four counties (Figures 18 through 21). Few years have spikes in only malignant tumor reporting. Carson City cumulative age-adjusted rates from 1974 to 1988, 1989 to 2003, and 2004 to 2011 were 10.1, 7.8, and 7.6 cases per 100,000 standard population, respectively. Lyon County cumulative age-adjusted rates from 1974 to 1988, 1989 to 2003, and 2004 to 2011 were 7.1, 6.8, and 7.8 cases per 100,000 standard population, respectively.

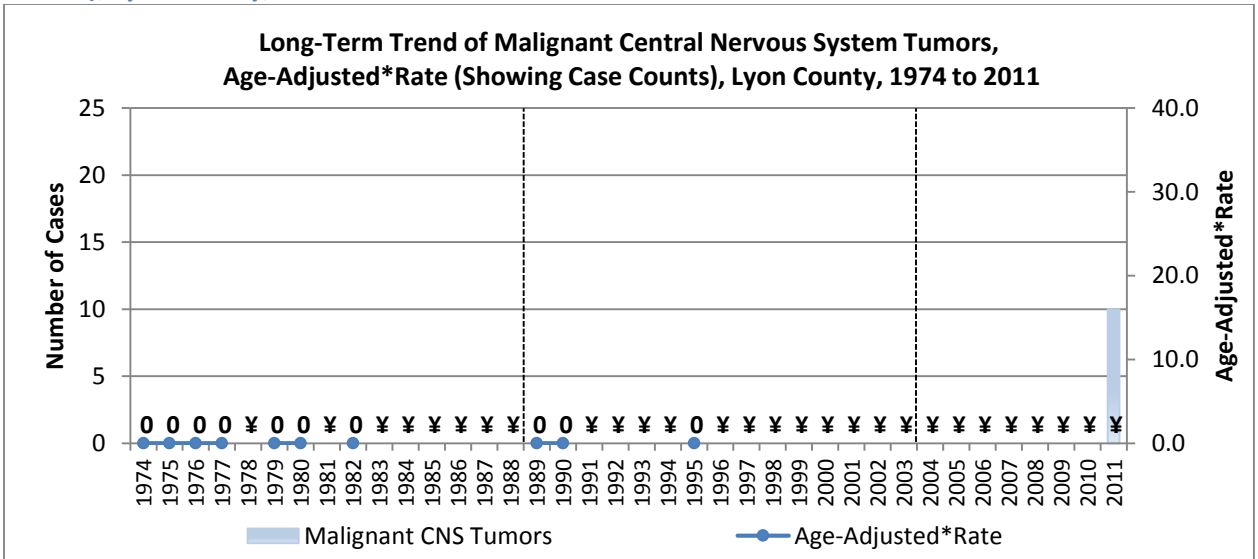
Figure 18: Long-Term Trend of Malignant Central Nervous System Tumors, Age-Adjusted*Rate (Showing Case Counts), Carson City, 1974 to 2011



¥ Counts more than zero or less than or equal to 5 or Rates with Relative Standard Error (RSE) >30% are suppressed due to reliability and/or confidentiality issues.

*Age-Adjusted to the 2000 US Census Standard Population

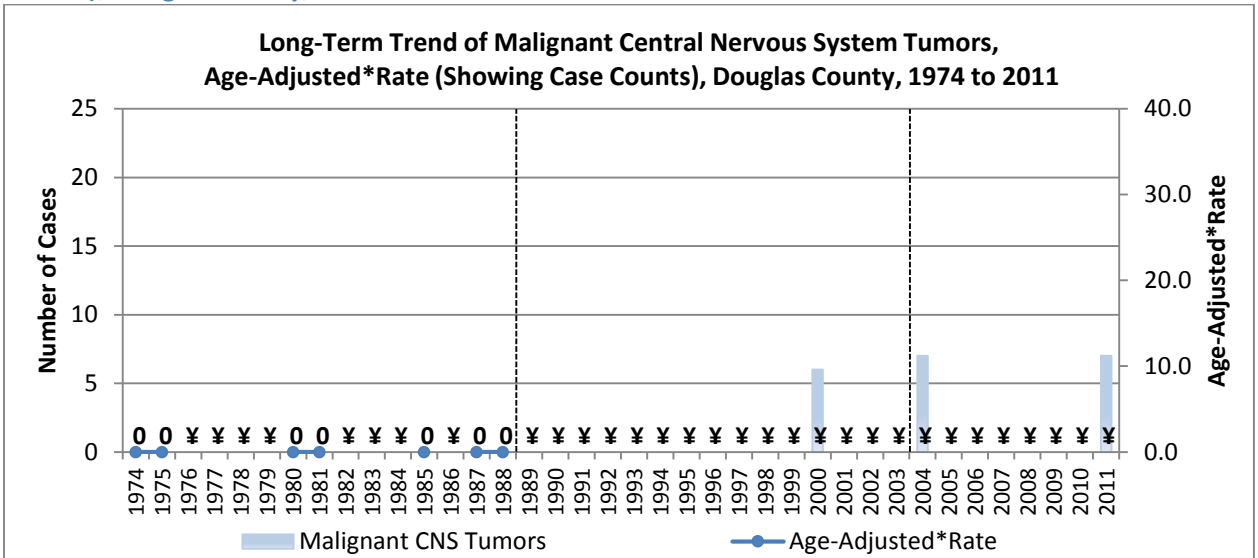
Figure 19: Long-Term Trend of Malignant Central Nervous System Tumors, Age-Adjusted*Rate (Showing Case Counts), Lyon County, 1974 to 2011



¥ Counts more than zero or less than or equal to 5 or Rates with Relative Standard Error (RSE) >30% are suppressed due to reliability and/or confidentiality issues.

*Age-Adjusted to the 2000 US Census Standard Population

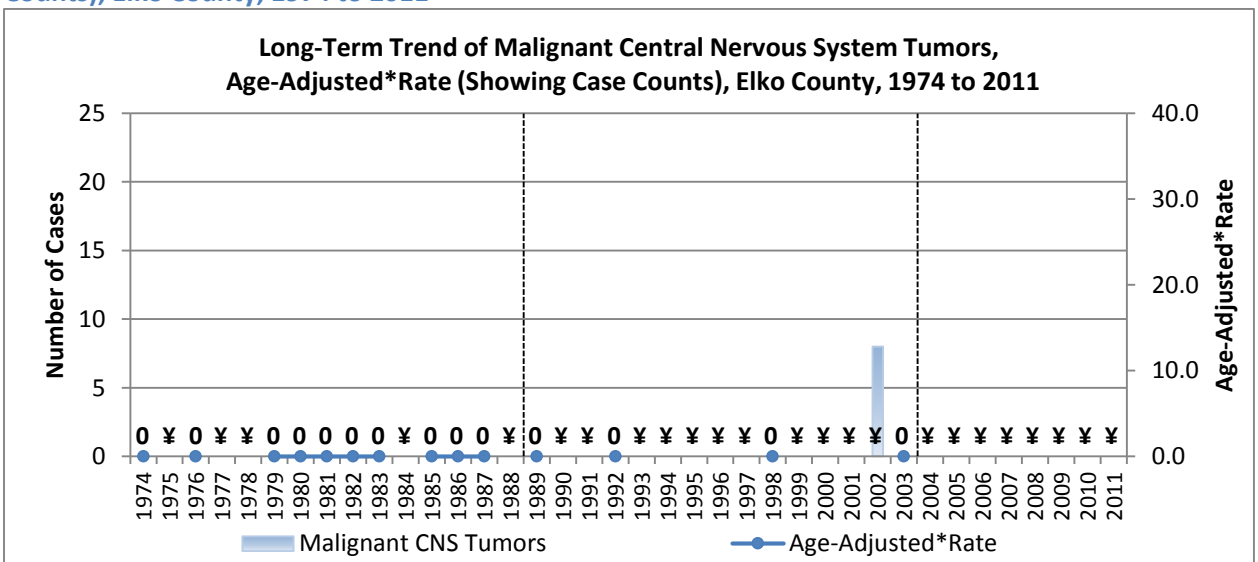
Figure 20: Long-Term Trend of Malignant Central Nervous System Tumors, Age-Adjusted*Rate (Showing Case Counts), Douglas County, 1974 to 2011



¥ Counts more than zero or less than or equal to 5 or Rates with Relative Standard Error (RSE) >30% are suppressed due to reliability and/or confidentiality issues.

*Age-Adjusted to the 2000 US Census Standard Population

Figure 21: Long-Term Trend of Malignant Central Nervous System Tumors, Age-Adjusted*Rate (Showing Case Counts), Elko County, 1974 to 2011



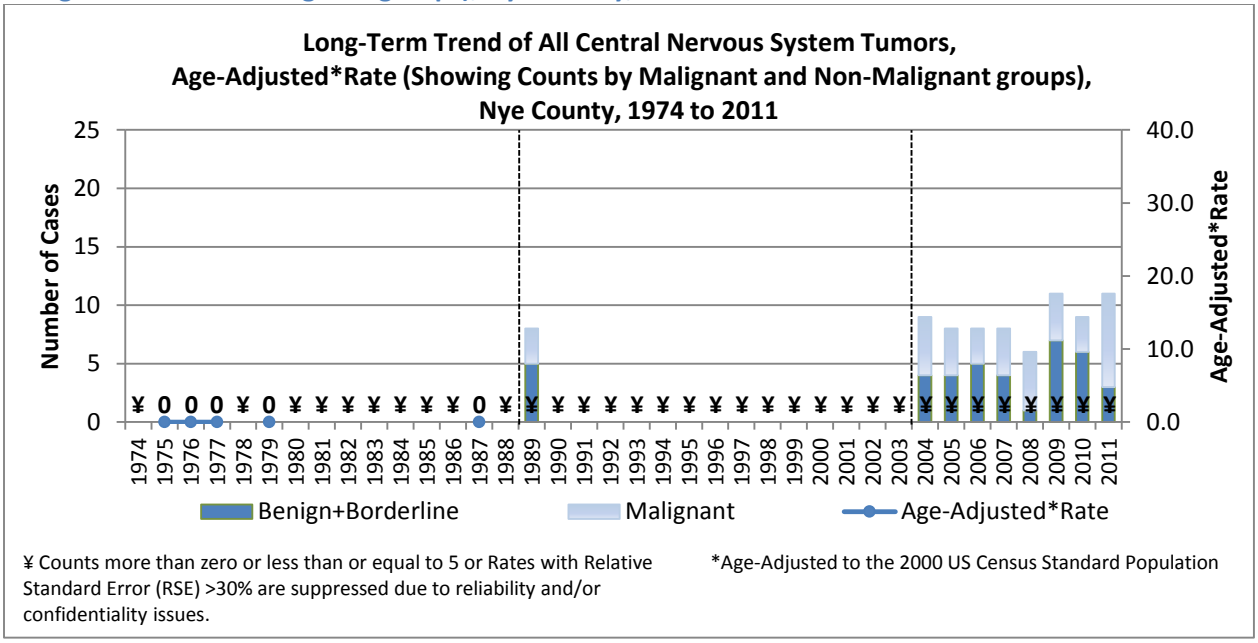
¥ Counts more than zero or less than or equal to 5 or Rates with Relative Standard Error (RSE) >30% are suppressed due to reliability and/or confidentiality issues.

*Age-Adjusted to the 2000 US Census Standard Population

Nye, Churchill, Humboldt, White Pine, Lander, Mineral, Pershing, Lincoln, Storey, Eureka, and Esmeralda County had populations less than 25,000, which consisted of 6.4% of the Nevada's average population from 1974-2011. Due to low case counts, age-adjusted annual rates for all CNS tumors were statistically unreliable for all observed years in all 11 counties (Figures 22 through 34). Only Nye and Churchill Counties had a few non-malignant cases reported after 2003 (Figures 22 through 25). Nye County cumulative age-adjusted rates from 1974 to 1988, 1989 to 2003, and 2004 to 2011 were 10.7, 9.9, and 15.5 cases per 100,000 standard population, respectively. Churchill County cumulative age-adjusted rates from 1974 to 1988, 1989 to 2003, and 2004 to 2011 were 11.6, 10.1, and 19.3 cases per 100,000 standard population, respectively. These cumulative age-adjusted rates were heavily influenced by the small population sizes living in these counties.

Although the nine smallest counties in Nevada (Humboldt, White Pine, Lander, Mineral, Pershing, Lincoln, Storey, Eureka, and Esmeralda County) had a few malignant and non-malignant cases reported between 1974 and 2011, due to low case counts, age-adjusted annual rates for all CNS tumors were statistically unreliable (Figures 26 through 34). Trends were not definable for all 11 counties.

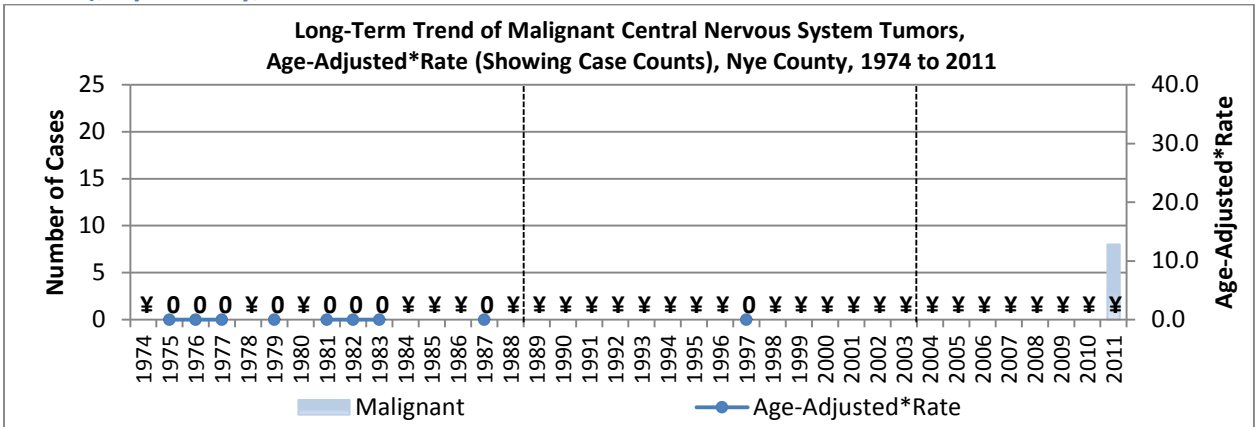
Figure 22: Long-Term Trend of All Central Nervous System Tumors, Age-Adjusted*Rate (Showing Counts by Malignant and Non-Malignant groups), Nye County, 1974 to 2011



¥ Counts more than zero or less than or equal to 5 or Rates with Relative Standard Error (RSE) >30% are suppressed due to reliability and/or confidentiality issues.

*Age-Adjusted to the 2000 US Census Standard Population

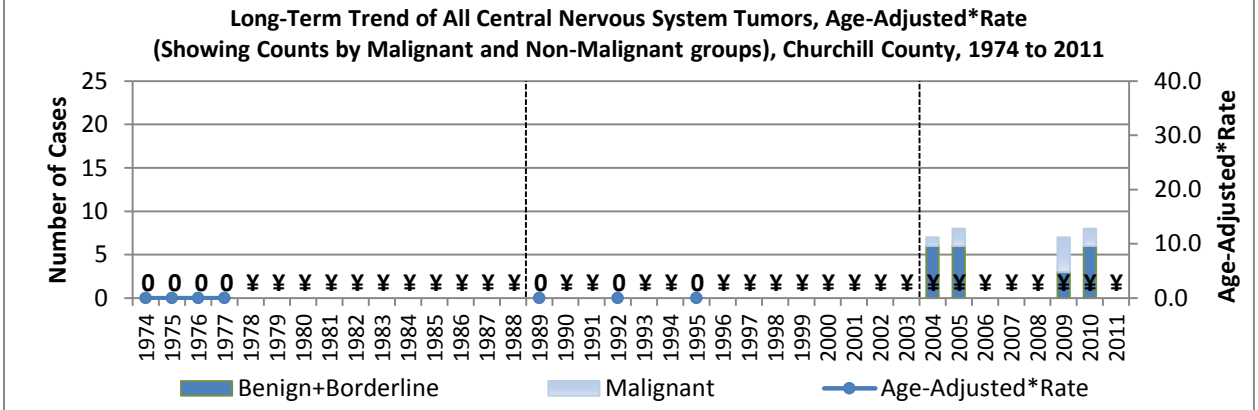
Figure 23: Long-Term Trend of Malignant Central Nervous System Tumors, Age-Adjusted*Rate (Showing Case Counts), Nye County, 1974 to 2011



¥ Counts more than zero or less than or equal to 5 or Rates with Relative Standard Error (RSE) >30% are suppressed due to reliability and/or confidentiality issues.

*Age-Adjusted to the 2000 US Census Standard Population

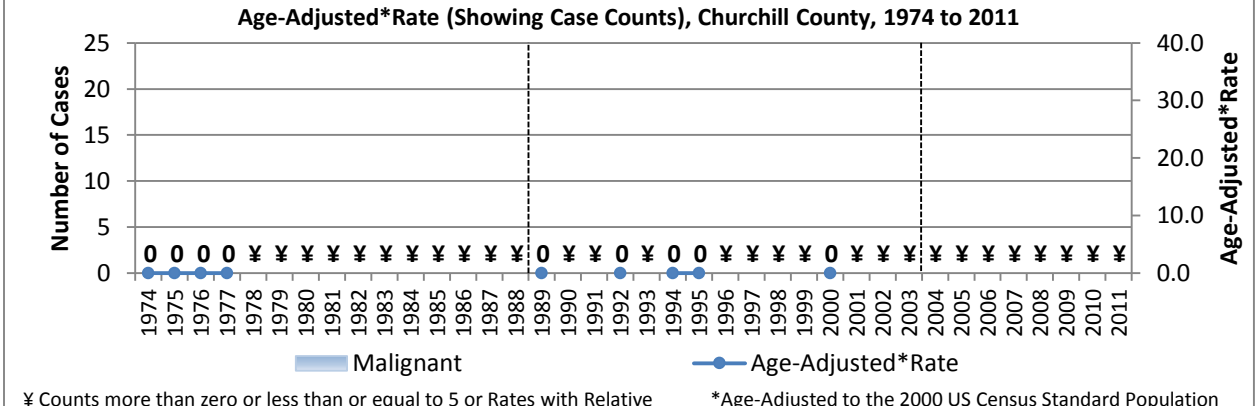
Figure 24: Long-Term Trend of All Central Nervous System Tumors, Age-Adjusted*Rate (Showing Counts by Malignant and Non-Malignant groups), Churchill County, 1974 to 2011



¥ Counts more than zero or less than or equal to 5 or Rates with Relative Standard Error (RSE) >30% are suppressed due to reliability and/or confidentiality issues.a

*Age-Adjusted to the 2000 US Census Standard Population

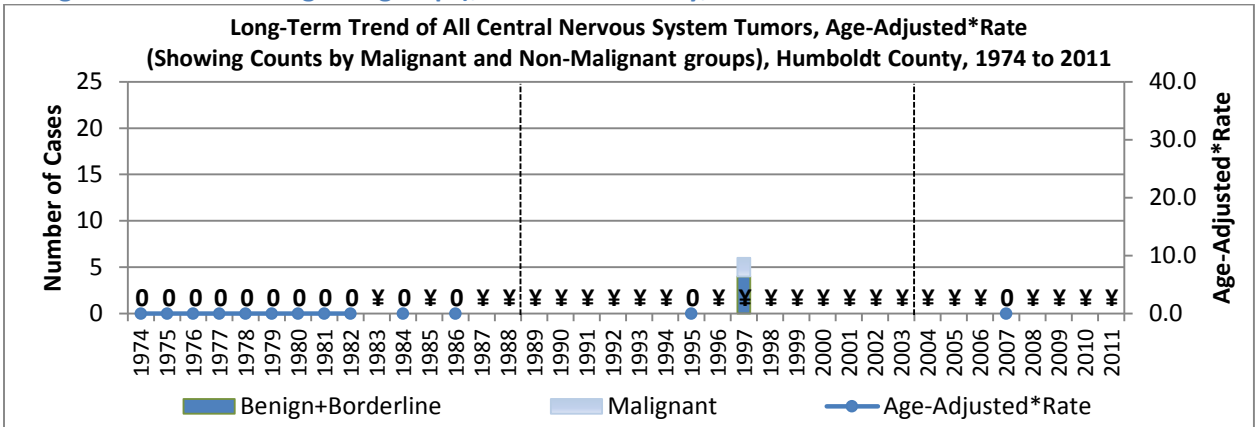
Figure 25: Long-Term Trend of Malignant Central Nervous System Tumors, Age-Adjusted*Rate (Showing Case Counts), Churchill County, 1974 to 2011



¥ Counts more than zero or less than or equal to 5 or Rates with Relative Standard Error (RSE) >30% are suppressed due to reliability and/or confidentiality issues.

*Age-Adjusted to the 2000 US Census Standard Population

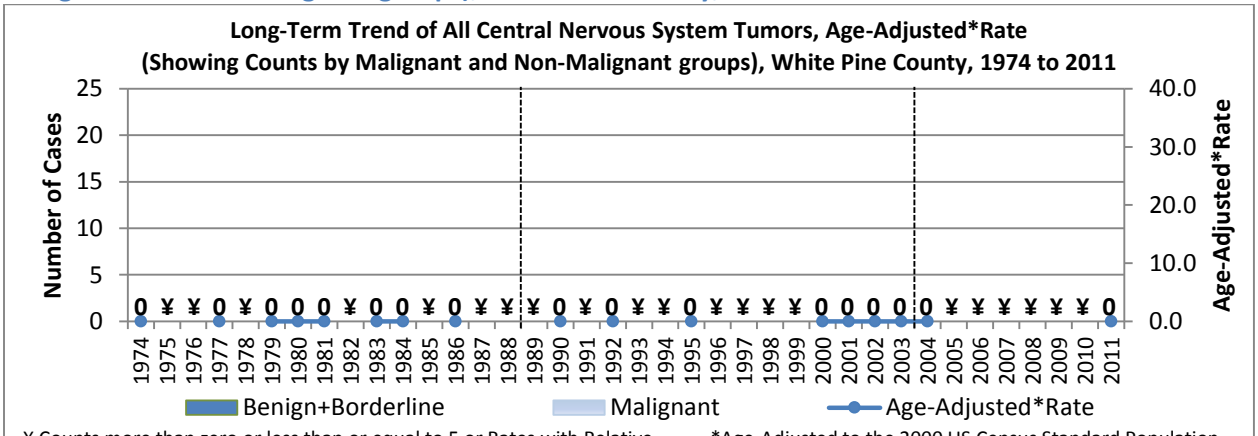
Figure 26: Long-Term Trend of All Central Nervous System Tumors, Age-Adjusted*Rate (Showing Counts by Malignant and Non-Malignant groups), Humboldt County, 1974 to 2011



¥ Counts more than zero or less than or equal to 5 or Rates with Relative Standard Error (RSE) >30% are suppressed due to reliability and/or confidentiality issues.

*Age-Adjusted to the 2000 US Census Standard Population

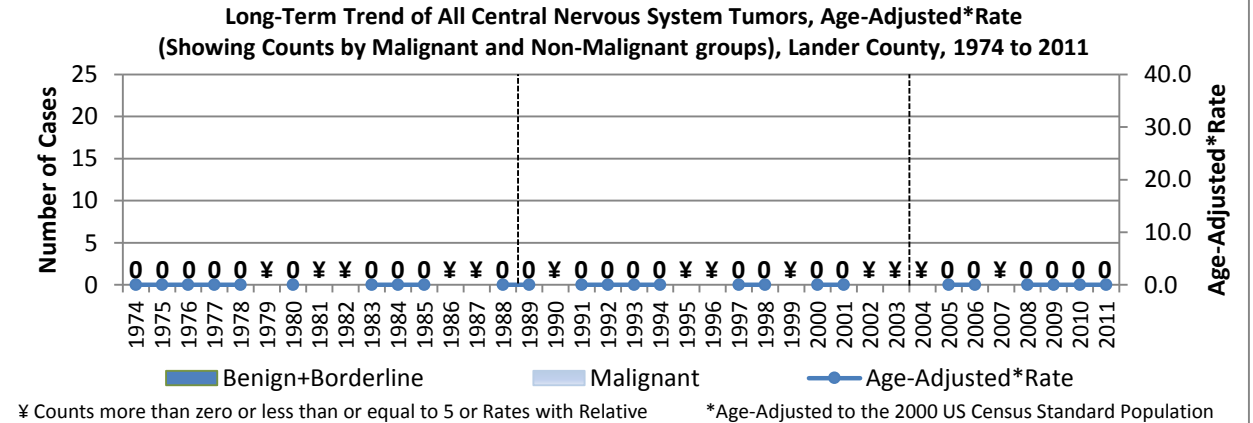
Figure 27: Long-Term Trend of All Central Nervous System Tumors, Age-Adjusted*Rate (Showing Counts by Malignant and Non-Malignant groups), White Pine County, 1974 to 2011



¥ Counts more than zero or less than or equal to 5 or Rates with Relative Standard Error (RSE) >30% are suppressed due to reliability and/or confidentiality issues.

*Age-Adjusted to the 2000 US Census Standard Population

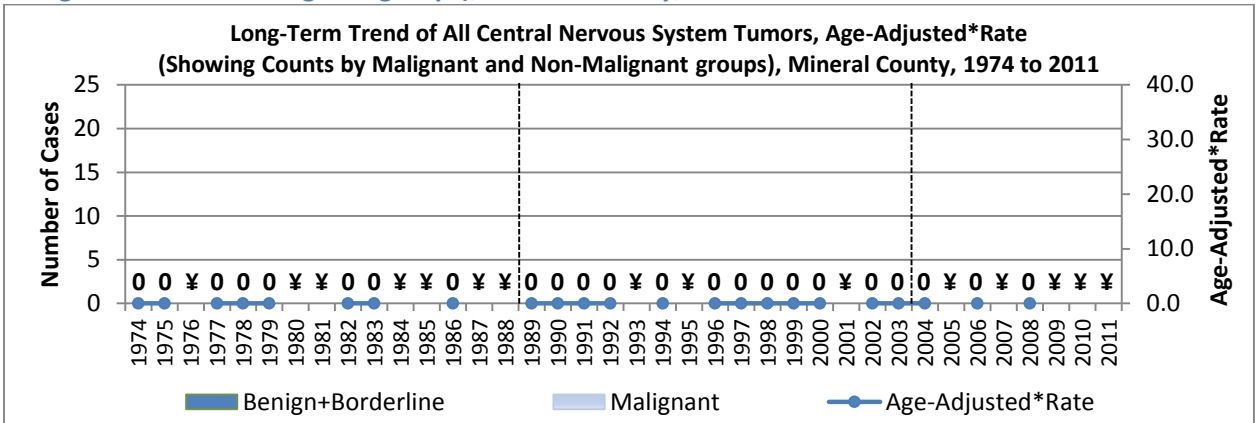
Figure 28:Long-Term Trend of All Central Nervous System Tumors, Age-Adjusted*Rate (Showing Counts by Malignant and Non-Malignant groups), Lander County, 1974 to 2011



¥ Counts more than zero or less than or equal to 5 or Rates with Relative Standard Error (RSE) >30% are suppressed due to reliability and/or confidentiality issues.

*Age-Adjusted to the 2000 US Census Standard Population

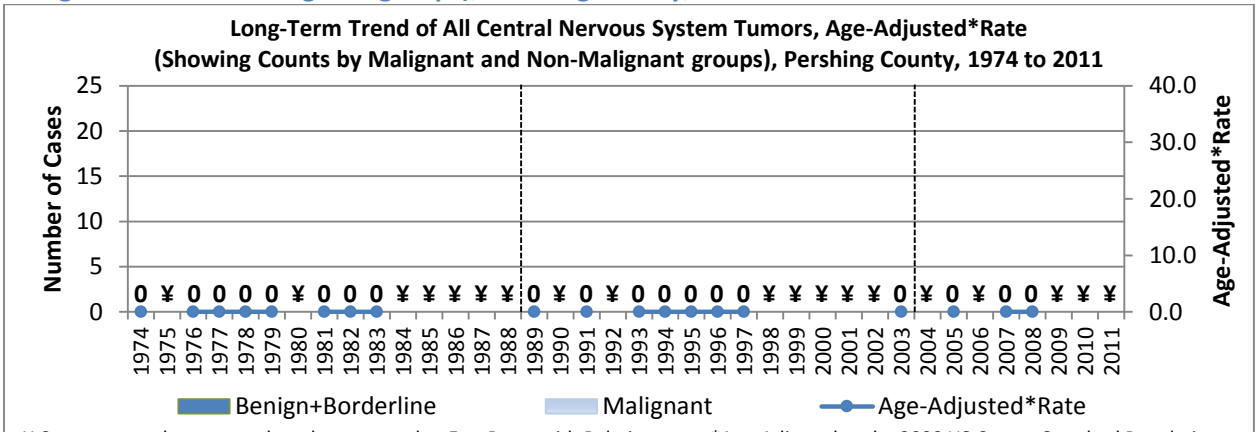
Figure 29: Long-Term Trend of All Central Nervous System Tumors, Age-Adjusted*Rate (Showing Counts by Malignant and Non-Malignant groups), Mineral County, 1974 to 2011



¥ Counts more than zero or less than or equal to 5 or Rates with Relative Standard Error (RSE) >30% are suppressed due to reliability and/or confidentiality issues.

*Age-Adjusted to the 2000 US Census Standard Population

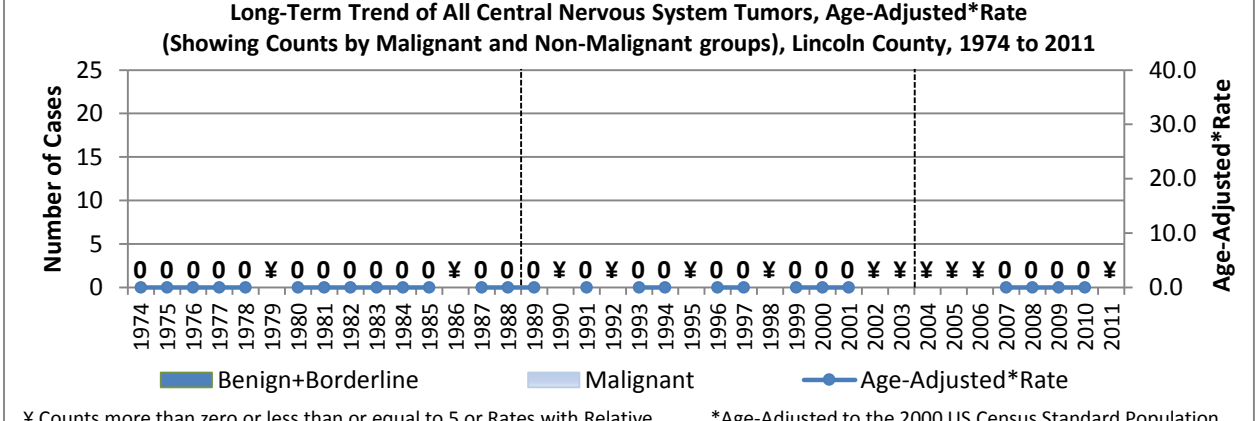
Figure 30: Long-Term Trend of All Central Nervous System Tumors, Age-Adjusted*Rate (Showing Counts by Malignant and Non-Malignant groups), Pershing County, 1974 to 2011



¥ Counts more than zero or less than or equal to 5 or Rates with Relative Standard Error (RSE) >30% are suppressed due to reliability and/or confidentiality issues.

*Age-Adjusted to the 2000 US Census Standard Population

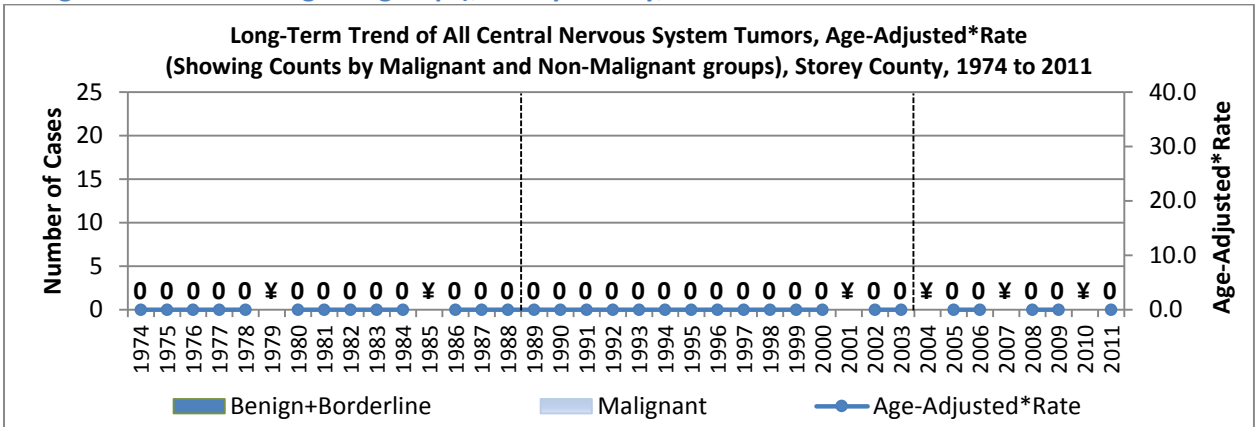
Figure 31: Long-Term Trend of All Central Nervous System Tumors, Age-Adjusted*Rate (Showing Counts by Malignant and Non-Malignant groups), Lincoln County, 1974 to 2011



¥ Counts more than zero or less than or equal to 5 or Rates with Relative Standard Error (RSE) >30% are suppressed due to reliability and/or confidentiality issues.

*Age-Adjusted to the 2000 US Census Standard Population

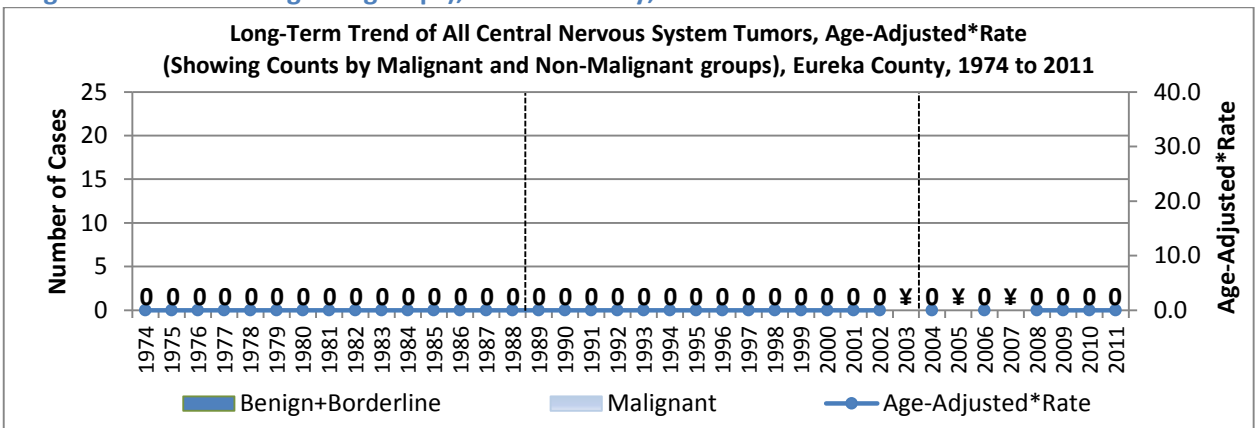
Figure 32: Long-Term Trend of All Central Nervous System Tumors, Age-Adjusted*Rate (Showing Counts by Malignant and Non-Malignant groups), Storey County, 1974 to 2011



¥ Counts more than zero or less than or equal to 5 or Rates with Relative Standard Error (RSE) >30% are suppressed due to reliability and/or confidentiality issues.

*Age-Adjusted to the 2000 US Census Standard Population

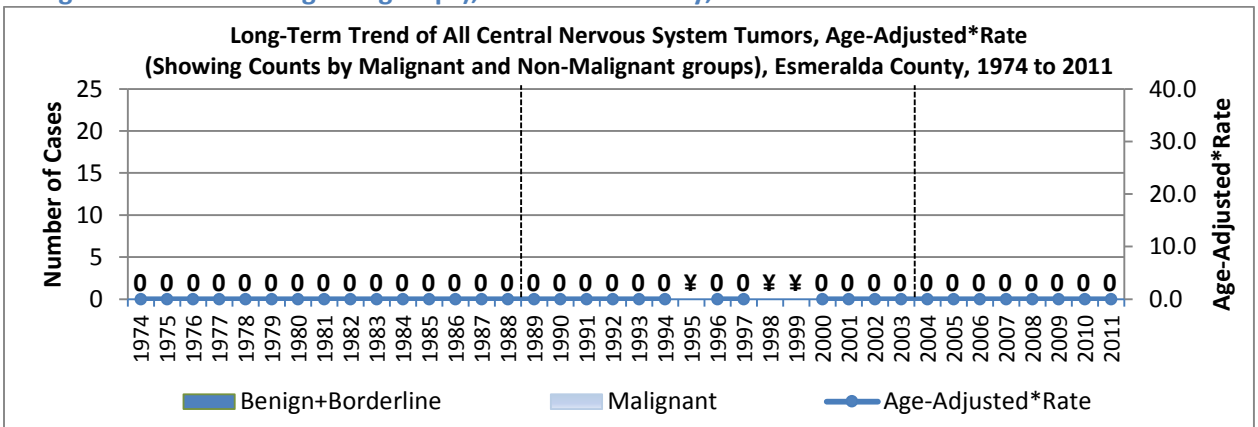
Figure 33: Long-Term Trend of All Central Nervous System Tumors, Age-Adjusted*Rate (Showing Counts by Malignant and Non-Malignant groups), Eureka County, 1974 to 2011



¥ Counts more than zero or less than or equal to 5 or Rates with Relative Standard Error (RSE) >30% are suppressed due to reliability and/or confidentiality issues.

*Age-Adjusted to the 2000 US Census Standard Population

Figure 34: Long-Term Trend of All Central Nervous System Tumors, Age-Adjusted*Rate (Showing Counts by Malignant and Non-Malignant groups), Esmeralda County, 1974 to 2011

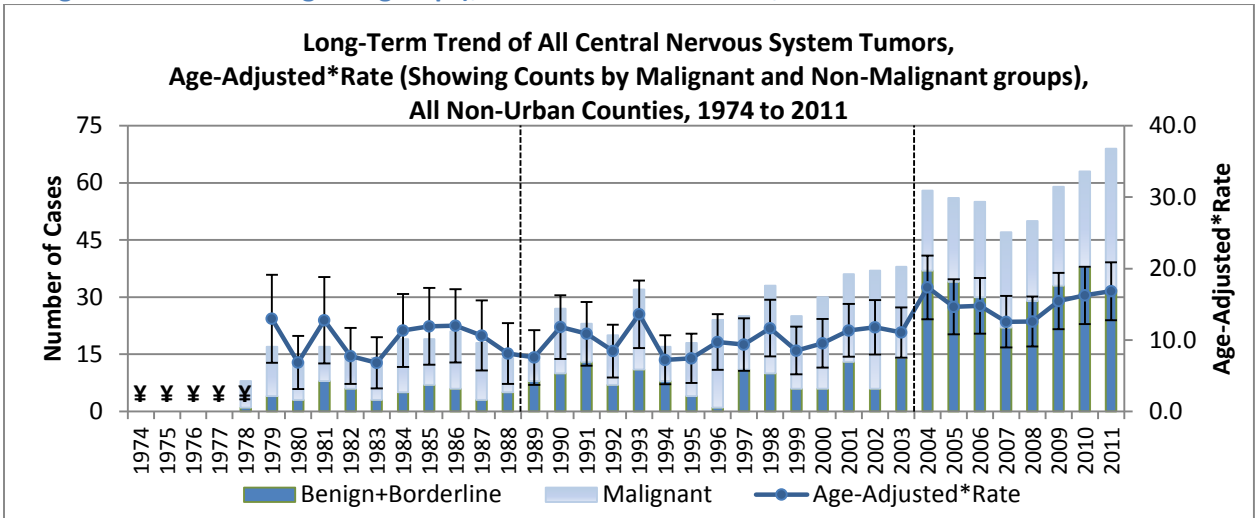


¥ Counts more than zero or less than or equal to 5 or Rates with Relative Standard Error (RSE) >30% are suppressed due to reliability and/or confidentiality issues.

*Age-Adjusted to the 2000 US Census Standard Population

Rural Counties

Figure 35: Long-Term Trend of All Central Nervous System Tumors, Age-Adjusted*Rate (Showing Counts by Malignant and Non-Malignant groups), All Non-Urban Counties, 1974 to 2011



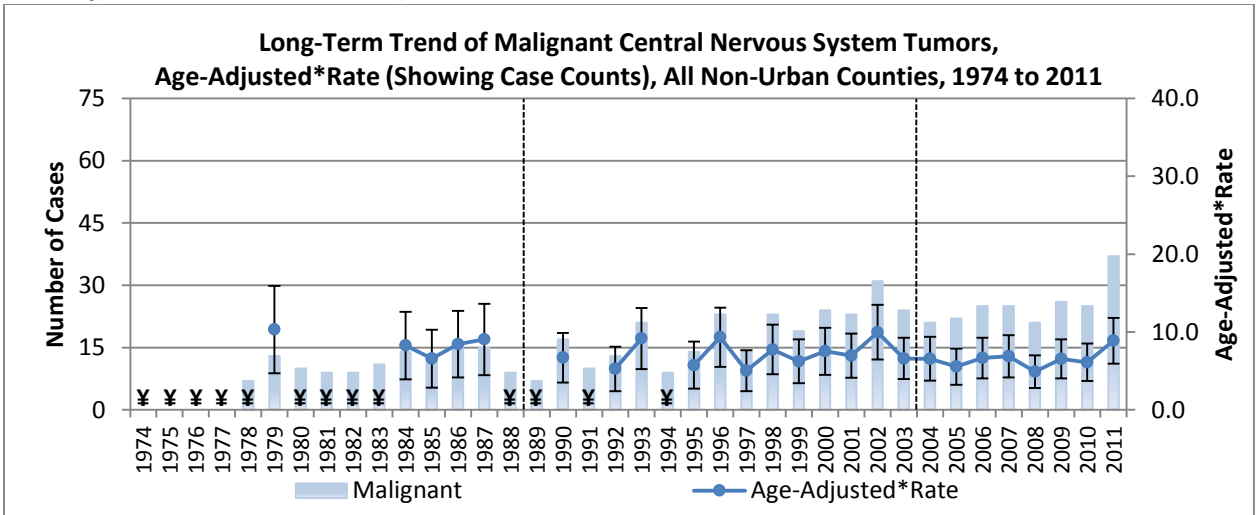
¥ Counts more than zero or less than or equal to 5 or Rates with Relative Standard Error (RSE) >30% are suppressed due to reliability and/or confidentiality issues.

*Age-Adjusted to the 2000 US Census Standard Population

Due to low case counts and unreliable age-adjusted annual rates in individual non-urban counties, all counties with an average population less than 50,000 from 1974 to 2011 were combined and classified as "All Non-Urban Counties". Prior to 2004, all non-urban counties had inconsistent case reporting. Due to low case counts, age-adjusted annual rates for all CNS tumors were statistically unreliable from 1974 to 1978. Cumulative age-adjusted rates from 1974 to 1988, 1989 to 2003, and 2004 to 2011 were 8.5, 10.2, and 15.1 cases per 100,000 standard population, respectively. Caution is warranted during interpretation due to wide confidence intervals (Figure 35).

Due to low case counts, age-adjusted annual rates for only malignant tumors were statistically unreliable for a few years prior to 1995. This is likely due to the initial CDC funding to the Nevada Central Cancer Registry. Cumulative age-adjusted rates from 1995 to 2003 was 6.3 cases per 100,000 standard population (Figure 36).

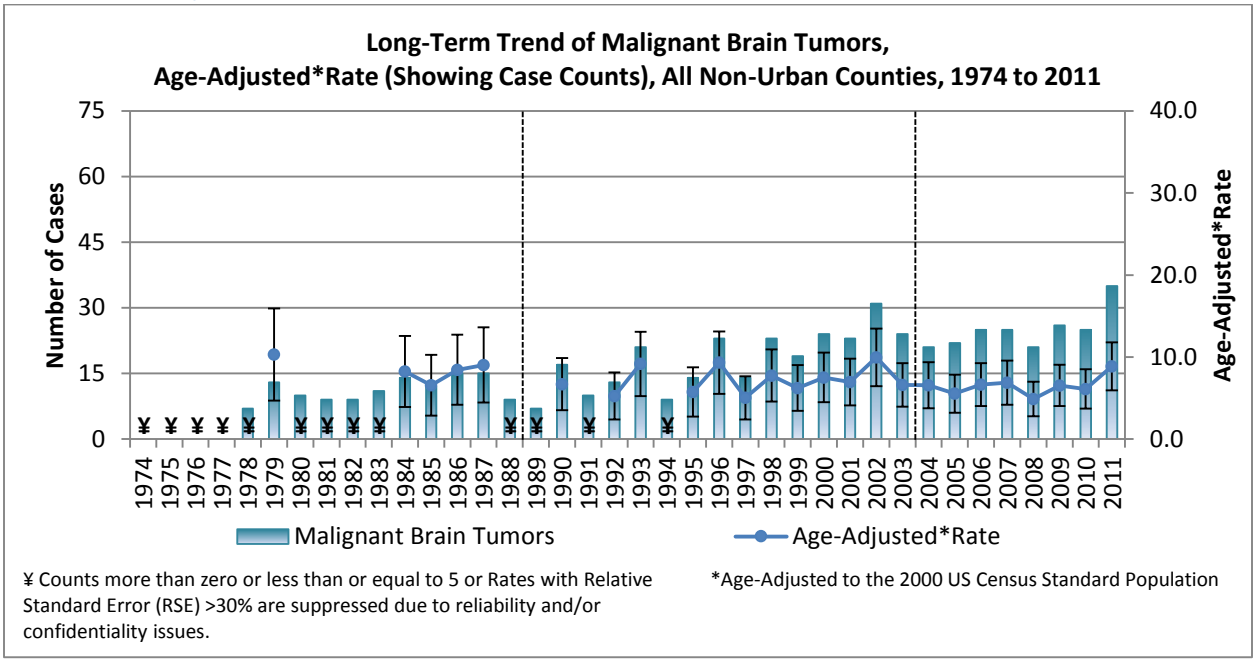
Figure 36: Long-Term Trend of Malignant Central Nervous System Tumors, Age-Adjusted*Rate (Showing Case Counts), All Non-Urban Counties, 1974 to 2011



¥ Counts more than zero or less than or equal to 5 or Rates with Relative Standard Error (RSE) >30% are suppressed due to reliability and/or confidentiality issues.

*Age-Adjusted to the 2000 US Census Standard Population

Figure 37: Long-Term Trend of Malignant Brain Tumors, Age-Adjusted*Rate (Showing Case Counts), All Non-Urban Counties, 1974 to 2011



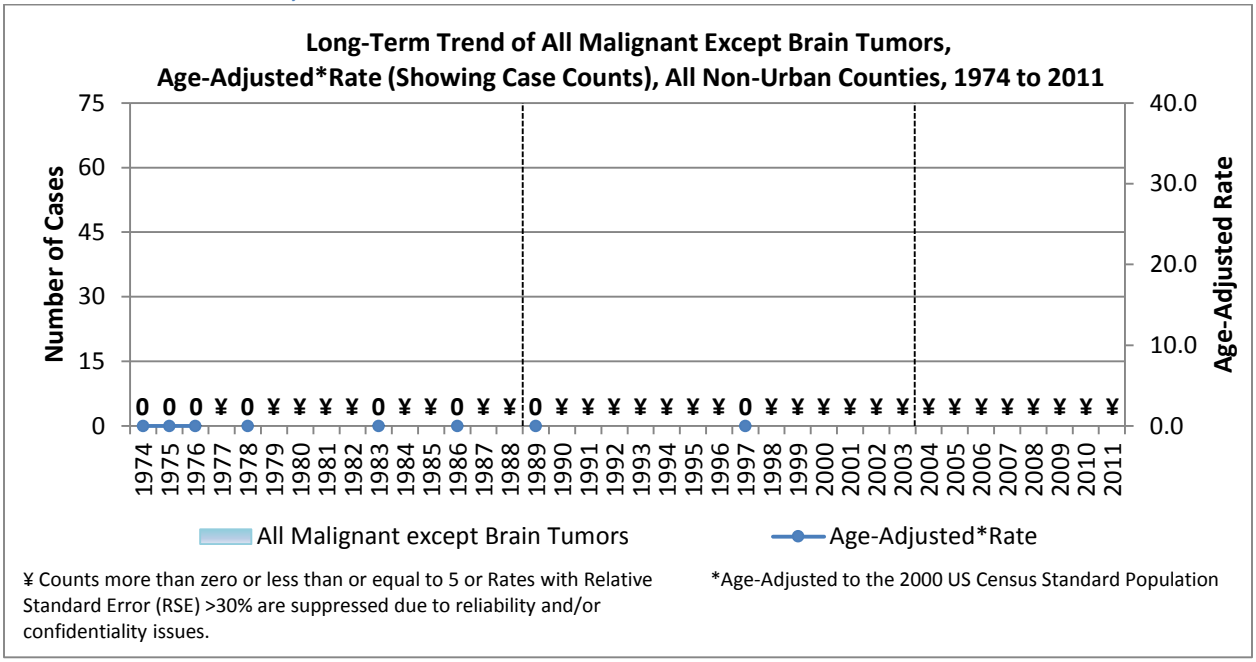
¥ Counts more than zero or less than or equal to 5 or Rates with Relative Standard Error (RSE) >30% are suppressed due to reliability and/or confidentiality issues.

*Age-Adjusted to the 2000 US Census Standard Population

Similar to urban counties, malignant brain tumors represented the majority of only malignant tumors. Due to low case counts, age-adjusted annual rates for malignant brain tumors were statistically unreliable for a few years prior to 1995. Reliable annual rates ranged between 4.4 and 8.4 cases per 100,000 standard population. Cumulative age-adjusted rates from 1974 to 1988, 1989 to 2003, and 2004 to 2011 were 4.9, 5.8, and 5.8 cases per 100,000 standard population, respectively.

Due to low case counts, age-adjusted annual rates for all other malignant except brain tumors were statistically unreliable for all observed years. Cumulative age-adjusted rates from 1974 to 1988, 1989 to 2003, and 2004 to 2011 were 1.0, 1.0, and 0.8 cases per 100,000 standard population, respectively (Figure 38).

Figure 38: Long-Term Trend of All Malignant Except Brain Tumors, Age-Adjusted*Rate (Showing Case Counts), All Non-Urban Counties, 1974 to 2011



¥ Counts more than zero or less than or equal to 5 or Rates with Relative Standard Error (RSE) >30% are suppressed due to reliability and/or confidentiality issues.

*Age-Adjusted to the 2000 US Census Standard Population

Conclusions

This report assessed reported CNS Tumors from 1974 to 2011 as: all CNS tumors (including benign and borderline tumors), only malignant tumors, malignant brain tumors, and all other malignant tumors except brain tumors. Landmark dates that affected CNS tumor reporting to the NCCR include: when the NCCR began collecting CNS tumor data (1974); BTWG recommendation to report non-malignant CNS tumors (1989); CDC NPCR funding for NCCR operations (1995); and Public Law 107-260 required the reporting of non-malignant brain and CNS tumors (2004). There was sparse reporting of non-malignant CNS tumors from 1978 to 2003 in Nevada and significant increases in benign and borderline CNS tumors from 2004 to 2011 in Clark County, Washoe County, and non-urban counties. Since size and experience of NCCR staff can impact the quality and quantity of data, caution should be exercised when interpreting counts and rates of CNS tumors prior to 1995. In addition, due to the increase in volume of reported non-malignant CNS tumors to the NCCR after the implementation of Public Law 107-260, counts and rates of benign/borderline and malignant CNS tumors should be interpreted separately. Furthermore, benign and borderline tumors in Nevada should not be utilized in studies when examining years prior to 2004.

In Nevada, brain tumors are the most frequent type of malignant CNS tumors (>60%). Brain tumors have a stable incidence trend from 1978 to 2011 with a cumulative age-adjusted rate of 5.6 cases per 100,000 standard population. All other malignant CNS tumors were infrequent with age-adjusted annual rates of zero or unreliable and a cumulative age-adjusted rate from 1995 to 2011 of 0.8 cases per 100,000 standard population. Non-malignant CNS tumors reporting were steadily reported since 2004 and accounts for 59.7% of all reported CNS tumors. From 2004 to 2011, the cumulative annual age-adjusted rate was 16.3 cases per 100,000 standard population. Trends for this non-malignant CNS tumors were relatively stable and lower than the national cumulative age-adjusted rate of 26.0 cases per 100,000 standard population. In terms of age, older populations, aged 24-74, were more affected by malignant brain tumors than younger populations, aged 0-24. Cumulative age-adjusted rates for older and younger populations were 6.8 and 1.6 cases per 100,000 standard population, respectively.

Although county level data was available at the NCCR, due to the relative rarity of CNS tumor incidence, most rural and frontier counties had unreliable or no incidence of CNS tumors during the observed period. Thus for this report, all rural and frontier counties were consolidated as “non-urban counties”. However, this blanket term does conceal county level differences that may impact the incidence of CNS tumors. Due to the relatively small populations in non-urban counties and few counts of CNS tumors, there was large variability in calculated age-adjusted rates. Consequently, a trend cannot be established and confidence intervals should be considered when comparing rates with other geographical regions.

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