



Published in final edited form as:

Pediatr Blood Cancer. 2025 November ; 72(11): e31976. doi:10.1002/pbc.31976.

Pediatric and young adult cancer incidence in the United States during the COVID-19 pandemic

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Abstract

Background: Cancer incidence decreased during the COVID-19 pandemic; this study describes cancer incidence changes for children, adolescents, and young adults during this period. We used US Cancer Statistics (USCS) to describe potential impacts of the pandemic on cancer incidence for persons 0–39 years.

Methods: We used data from USCS, covering 98% of the US population, to evaluate cancer case counts, incidence rates, and monthly counts; incidence rate ratios were calculated comparing year 2019 (baseline) to 2020 and 2021. We calculated trends using joinpoint regression for the period 2003–2021.

Results: Comparing 2019 to 2020, cancer incidence decreased 5% (95% confidence interval [CI], 3%–7%) for ages 0–19 years and 7% (95% CI, 6%–8%) for ages 20–39. For ages 0–19, decreases were seen for thyroid cancer, melanoma, and nonmalignant central nervous system (CNS) neoplasms. For ages 20–39, decreases were seen for leukemias, lymphomas, CNS neoplasms, sarcomas, melanoma, and some carcinoma types. Decreases in 2020 were least pronounced for distant stage at diagnosis. For ages 0–39, new diagnoses were lowest during March or April 2020 but returned to pre-pandemic levels during the second half of 2020. Decreases in 2021 were consistent with previously decreasing trends for many cancer types.

Conclusions: Cancer rate decreases were largest for young adults (vs. children) and were significant for some cancer types. These findings might help assess impacts of the COVID-19

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Statements and Declarations: The findings and conclusions in this manuscript are those of the authors and do not necessarily represent the official position of the Centers for Disease Control and Prevention.

Ethics Statement: This activity was determined by CDC to be public health surveillance.

pandemic, inform investigations into potential causes of these decreases, and guide responses to future public health crises.

Keywords

cancer; pediatric; young adult; COVID-19; incidence; registries

Introduction

The COVID-19 pandemic, which was declared a national emergency in the United States on March 13, 2020,¹ impacted cancer care in the United States, resulting in delayed cancer screening and diagnosis.^{2–4} Past studies using US cancer registry data have described lower cancer incidence rates in 2020 compared to earlier years, coinciding with COVID-related stay-at-home orders during the spring months of 2020.^{5–9} Analysis of pathology reports and diagnosis records of cancer—mostly affecting adults during this time period—suggest that decreased cancer incidence was due to decreased diagnosis as opposed to operational delays of cancer reporting.^{5,10} However, the impact of the COVID-19 pandemic on US national reporting of childhood, adolescent, and young adult cancer has not been thoroughly studied. Reports of decreased cancer incidence in 2020 compared to earlier years, using population-based cancer registries, have mostly focused on all ages or adults, and focused on cancer types that mostly affect adults (e.g., prostate, colon, lung).^{5–7,11} Descriptions of how the COVID-19 pandemic affected cancer diagnoses among children, adolescents, and young adults have been more limited, such as in reports of local areas or lower in population coverage.^{12–17}

It has also been shown that pediatric cancer care was affected by the COVID-19 pandemic, including delayed treatment and complications due to SARS-CoV-2 infections.^{18–21} But it is less clear how pediatric cancer incidence was affected as described by population-based databases. Therefore, we sought to report trends in pediatric and young adult new cancer cases as well as incidence rates—during 2020 and 2021 compared to 2019—using data representing 98% of the US population; the aim was to determine potential disruptions in cancer diagnoses during the initial years of the COVID-19 pandemic.

Methods

The US Cancer Statistics (USCS) analytic database²² was used to describe new cases of cancer during 2003 to 2021 using methodology that has been described previously.²³ USCS, which covers all US states and the District of Columbia (DC), encompasses cancer registries that contribute to the National Program of Cancer Registries (NPCR) and to the Surveillance, Epidemiology, and End Results (SEER) program. However, this study included 98% of the US population during this time period. Indiana was excluded because its data did not meet the publication criteria for the entirety of the study period; data from all other states and DC met USCS publication criteria for 2003 to 2021.²⁴ This study included children (ages 0–14 years), adolescents (ages 15–19 years), and young adults (ages 20–39 years) diagnosed with either a malignant or nonmalignant tumor.²⁵ All ages (0–85+ years) were included for comparison and appear only in the supplemental material. Cases were

characterized by site and histology according to the *International Classification of Diseases for Oncology*, third edition.^{26,27} Cancer type was grouped according to the International Classification of Childhood Cancer (ICCC)^{28,29} for ages 0–19 years (defined here as pediatric ages) at diagnosis and the Adolescent and Young Adult (AYA) Site Recode 2020 Revision for ages 20–39 years.^{30,31} Race and ethnicity was categorized as Non-Hispanic American Indian or Alaska Native, Non-Hispanic Asian or Pacific Islander, Non-Hispanic Black (Black), Non-Hispanic White (White), and Hispanic or Latino (Hispanic). Stage was defined by merged summary stage (local, regional, distant, and unknown stage).³² Rural-urban status was characterized by 2013 Beale codes, which categorize counties into metropolitan vs. nonmetropolitan status by population size.³³

Age-adjusted incidence rates were reported per 1 million people for ages 0–19 years and per 100,000 people for ages 20–39 years; all ages were age-adjusted to the 2000 US standard population (19 age groups—Census P25–1130). Incidence rate ratios (IRR) were calculated to compare 2019 to 2020 and 2019 to 2021, with 2019 set as the reference rate; two-sided statistically significant IRRs were different at $p < .05$. Counts and rates were calculated overall and by sex, age, race and ethnicity, stage, US Census region, metropolitan status, and cancer type. Counts were additionally described by diagnosis month in 2019, 2020, and 2021. Incidence trends during 2003 to 2021 were assessed by calculating annual percent change (APC) to describe a single segment and average APC (AAPC) to describe a fixed interval.²³ Joinpoint analysis during 2003–2021 was performed to provide context for changes observed during 2019–2021. Based upon analysis from the National Cancer Institute, estimation of joinpoint trends excluded the year 2020 due to changes related to the COVID-19 pandemic but included cases diagnosed in 2021.^{9,34} Calculations were performed using SEER*Stat, version 8.4.3³⁵ and Joinpoint, version 5.2.0.0.³⁶ This study was a secondary analysis of deidentified data; institutional review board review was not needed.

Results

Among children and adolescents ages 0–19 years, 17,593 cases were reported in 2019, 16,622 in 2020, and 16,542 in 2021, with age-adjusted incidence rates of 215.3 per million, 205.0, and 206.8, respectively (Table 1). The IRR comparing 2019 to 2020 was 0.95 (95% confidence interval [CI], 0.93–0.97), indicating a 5% decrease, and comparing 2019 to 2021 was 0.96 (0.94–0.98), indicating a 4% decrease. Among those 0–19 years at diagnosis, rates were significantly lower in 2020 compared to 2019 overall, for both males and females, for ages 10–14 and 15–19 years, for White and Hispanic children and adolescents, and by cancer type for thyroid cancer, melanoma, and nonmalignant brain tumors. By cancer type, only thyroid cancer and nonmalignant central nervous system (CNS) neoplasm rates were significantly lower for both 2020 and 2021 than 2019; both of these tumor types had been previously increasing (Fig. 1). Lymphoma was significantly lower in 2021 than 2019, but this cancer type had a decreasing trend line independent of 2020 (Fig. 1: APC 2015–2021=–2.3).

Among young adults aged 20–39 years, 90,184 cases were reported in 2019, 84,058 in 2020, and 88,871 in 2021, with age-adjusted rates of 107.2 per 100,000, 99.5, and 104.9, respectively (Table 2). The IRR comparing 2019 to 2020 was 0.93 (95% CI, 0.92–0.94),

indicating a 7% decrease, and was 0.98 (0.97–0.99) comparing 2019 to 2021, indicating a 2% decrease. Overall, rates were significantly lower in 2020 compared to 2019: for both males and females; for all four 5-year age groups between 20 and 39 years; for all race and ethnicity groups; and by cancer type for leukemia, lymphoma, malignant and nonmalignant CNS neoplasms, sarcomas, melanomas, and several types of carcinoma. For young adults, multiple cancer types had lower rates in both 2020 and 2021 compared to 2019, including lymphoma, malignant and nonmalignant CNS neoplasms, sarcomas, melanoma, thyroid cancer, lung cancer, and carcinoma of the genital sites. Of these cancer types, lymphoma, malignant and nonmalignant CNS neoplasms, and melanoma had a decreasing trend independent of 2020 (Fig. 2).

By diagnosis month, for ages 0–19 years, the lowest counts during 2019 through 2021 occurred in March and April of 2020 (Fig. 3). April 2020 was the lowest count month for both sexes and for childhood and adolescent age groups, although the difference in counts was most pronounced in adolescents.

Similar patterns were seen in young adults aged 20–39 years; the lowest case count months from 2019 through 2021 occurred in March–May of 2020. Cancer case counts were lowest in April 2020 for both sexes and all 4 age groups, although the difference in counts was most pronounced in ages 35–39 years. For all ages 0–39, cancer case counts within each age group were similar in the months June–December across all 3 years. By diagnosis month and by cancer type (Fig. 4), the lowest count month was March 2020 for pediatric patients with leukemia (cases = 260), whereas April 2020 was the lowest count month during 2019–2021 for all other age groups and cancer types.

By stage at diagnosis, for ages 0–19 and 20–39 years, rates decreased for localized and regional stage, but rates were stable for distant stage when comparing 2019 to 2020. For ages 0–19 years, by month, the percentage of cases with distant stage was highest in April and June of 2020 compared to any other month during 2019 to 2021 (Supplemental Figure S1). For ages 20–39 years, the percentage of cases with distant stage was highest in April 2020 compared to any other month in 2019 to 2021. By US Census region, for ages 0–19 years, cases decreased in 2020 and 2021 compared to 2019 in the Midwest and South regions. For ages 20–39 years, cases decreased in 2020 for all regions and only for the Northeast and West in 2021. For pediatric ages, the IRR for 2020 showed a significant decrease in metropolitan but not nonmetropolitan counties. For ages 20–39 years, the IRR for 2020 showed a significant decrease in both metropolitan and nonmetropolitan counties, but it was lower in metropolitan counties.

For all ages combined (0–85+ years), rates were 10% lower in 2020 than 2019 and 4% lower in 2021 than 2019 (Supplemental Table S1). The percent decrease between 2019 and 2020 was higher in every 10-year age group ≥ 40 years (range 9%–10%) than in every age group < 40 years (range 2%–7%). Decreases in 2020 were more pronounced for ages ≥ 40 years compared to ages < 19 and 20–39 years (Supplemental Figure S2).

Discussion

Our large population-based study demonstrated that reported cancer incidence in the US decreased by 5% and 7% between 2019 and 2020 for patients aged 0–19 and 20–39 years, respectively, which was a smaller rate decrease than all ages combined (10%) (Supplemental Table S1). Significant decreases between 2019 and 2020 were seen only for certain cancer types and were not seen for ages 0–4 or 5–9 years. For ages 0–39 years by month, new diagnoses were lowest during March or April 2020 but then returned to prepandemic levels during the second half of 2020.

Previous studies reported that for all ages combined (0–85+ years), cancer incidence rates decreased by 9% to 11% from 2019 to 2020, and decreases in 2020 were more pronounced for older ages compared to pediatric and young adult ages.^{9,37,38} Notably for this study, rates did not significantly decrease comparing 2019 to 2020 for children diagnosed at ages 0–4 or 5–9 years, which is consistent with previous reports.^{16,37} Less pronounced decreases in pediatric ages could be related to differences in health care utilization, access to care, and cancer type³⁹—especially because cancer screening is not relevant to most pediatric cancer types.

By cancer type in ages 0–19 years, significant decreases in 2020 were seen only for thyroid cancer, malignant melanomas, and nonmalignant CNS neoplasms. These three cancer types were also among the types with the largest 2020 decreases among young adults ages 20–39 years. Thyroid and melanoma cancers are often diagnosed in outpatient settings in adolescents and adults, and decreases might be related to decreased routine health care utilization during 2020—including reduced imaging examinations, and discovery of thyroid cancer on imaging orders for reasons unrelated to cancer.^{5,6,9} Similarly, decreases in nonmalignant CNS neoplasms could be related to decreased incidental diagnoses secondary to decreased access to care or imaging.³⁹ The most common cancer types diagnosed in pediatric and young adults—such as leukemia, lymphoma, and malignant brain cancer, which are not subject to population-wide screening recommendations (e.g., for cervical, prostate, or lung cancer)^{40,41}—might be less affected by decreases in routine primary care visits compared to cancers associated with population-level screening recommendations.

Cancer incidence rates in 2021 were significantly lower than in 2019. However, rates were decreasing independently of 2020 rates for pediatric lymphoma, malignant CNS neoplasms, retinoblastoma, and germ cell tumors, and for ages 20–39 years, for lymphoma, malignant CNS neoplasms, and melanoma. For some pediatric cancer types that are associated with imaging-based or incidental diagnoses, such as thyroid cancer and nonmalignant CNS neoplasms, decreased rates in both 2020 and 2021 compared to 2019 might reflect continued impact of the COVID-19 pandemic and decreased utilization of health care services.^{39,42} These findings are consistent with data of mostly adult ages showing decreased cancer rates in 2020 and 2021 (with 2020 decreases being most pronounced) compared to 2019, and the decreased rates vary by cancer type.⁴³

Like monthly patterns seen for cancer types mostly affecting adults,^{5,6} for ages 0–39 years, decreases during the beginning of the COVID-19 pandemic in early 2020 generally

were not present in the second half of 2020. Notably, in June 2020 for ages 0–19 years, lymphoma counts were higher than in any other month in 2019, 2020, or 2021. In adults, decreases in new diagnoses of cancer in early 2020 were likely related to decreases in screening, decreases in surgical procedures, or other disruptions in care.^{3,5,44,45} Past studies have described reduced pediatric and young adult emergency department^{46–49} and primary care or routine visits^{49–51} during the spring months of 2020, which rebounded somewhat in later months of 2020. Emergency room visits were lower in 2020 than 2019 for all ages, but the percent decrease was larger for children compared to adolescents^{46,47} and children compared to adults.⁴⁸ A delay in medical care could explain the cancer incidence pattern observed in the spring of 2020 for pediatric and young adult ages, and this pattern may have impacted solid tumors or tumors with an outpatient diagnosis more than other cancer types.^{14,39} Some delays in diagnosis might have been related to symptom overlap of fatigue, distress, and disturbed sleep attributed to the COVID-19 pandemic.³⁹ Decreases in malignant and nonmalignant CNS tumors were similar to patterns described for ages 0–39 years by Cioffi et al., whereby the largest decreases in 2020 were seen in April 2020, and decreases in nonmalignant CNS tumors were greater than among people with malignant brain cancer.³⁹

Previous data looking at all ages showed decreases in 2020 for all racial and ethnic groups, which is consistent with findings here for ages 20–39 years.⁶ However, in this study we did not observe decreases in pediatric ages for Black, American Indian/Alaska Native, and Asian and Pacific Islander groups. By stage, the rate of patients diagnosed at distant stage did not decrease from 2019 to 2020 for both pediatric and young adult ages; however, the rate of localized and distant stage decreased from 2019 to 2020. This is consistent with previous data of adult cancers showing larger decreases in localized stage compared to distant stage between 2019 and 2020.^{11,43,52} It is possible that for pediatric cancer, some localized stage cancers, especially those diagnosed incidentally, might have not been detected or had delayed diagnosis, while distant stage cases were not widely missed during 2020, potentially due to greater likelihood of symptoms.³⁹ Differences by US Census region or metropolitan status might be related to differing impacts of the pandemic on cancer reporting, access to care, or utilization of route health services.⁵³

Our study must be considered in the light of certain limitations. First, the COVID-19 pandemic disrupted cancer reporting in both hospitals and central cancer registries;⁵⁴ it also may have impacted reported data as early as the 2018 diagnosis year and may have continued through the 2021 diagnosis year. It is possible that disruptions resulted in some underreporting of cases throughout this study's reporting period. It is not clear how potential underreporting might have affected cancers among those aged 0–39 years differently from cancers among older individuals. Some cancer types are reported late, especially those diagnosed at outpatient clinics, and might not be included in this database version. However, including 2021 data in this study allowed for additional time to add late-reported cases diagnosed during 2020. Second, our evaluation of stage excluded leukemia (because almost all cases were coded as distant) and germ cell tumors (>45% of cases were coded as unknown or blank stage). Third, merged summary stage captured in the USCS database does not match clinical staging for many cancer types. Finally, not all nonmalignant cases are

collected by central cancer registries, and nonmalignant CNS cases were included in this study only beginning in 2005.⁵⁵

This study provides context for how the COVID-19 pandemic may have impacted pediatric and young adult cancer diagnoses. The COVID-19 pandemic did not seem to have as large of an impact on cancer incidence in pediatric patients compared to adult patients; the impact was greater for cancers diagnosed in adolescents and young adults and in certain cancer types, such as thyroid and nonmalignant brain tumors. Analysis of incidence data over subsequent years will help determine if patterns observed here during 2020 and 2021 resulted from decreased diagnosis as opposed to decreased reporting. Nevertheless, diagnosis patterns observed in this study could be helpful to researchers in interpreting cancer mortality and survival data during this time period, evaluating other markers of cancer care (e.g., intensive care unit admissions), assessing future incidence trends, and informing responses to future public health crises that affect pediatric and young adult populations.^{43,56,57}

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

Acknowledgement:

State health departments and cancer registrars.

Conflicts of interest:

The authors declare no relevant conflicts of interest except for the following:

Dr. Durbin serves on two boards of directors:

President, North American Association of Central Cancer Registries.

Board Member, Kentucky Pediatric Cancer Research Trust Fund, a board that oversees state funding for pediatric cancer research in Kentucky.

Dr. Durbin does not receive any compensation for his service on these boards.

Data Availability Statement:

The data that support the findings of this study are available on request by contacting uscsdata@cdc.gov.

Abbreviations key:

AYA	adolescent and young adult
APC	annual percent change
AAPC	average annual percent change
CNS	central nervous system
CI	confidence interval

DC	District of Columbia
IRR	incidence rate ratio
ICCC	International Classification of Childhood Cancer
NPCR	National Program of Cancer Registries
SEER	Surveillance, Epidemiology, and End Results
USCS	US Cancer Statistics

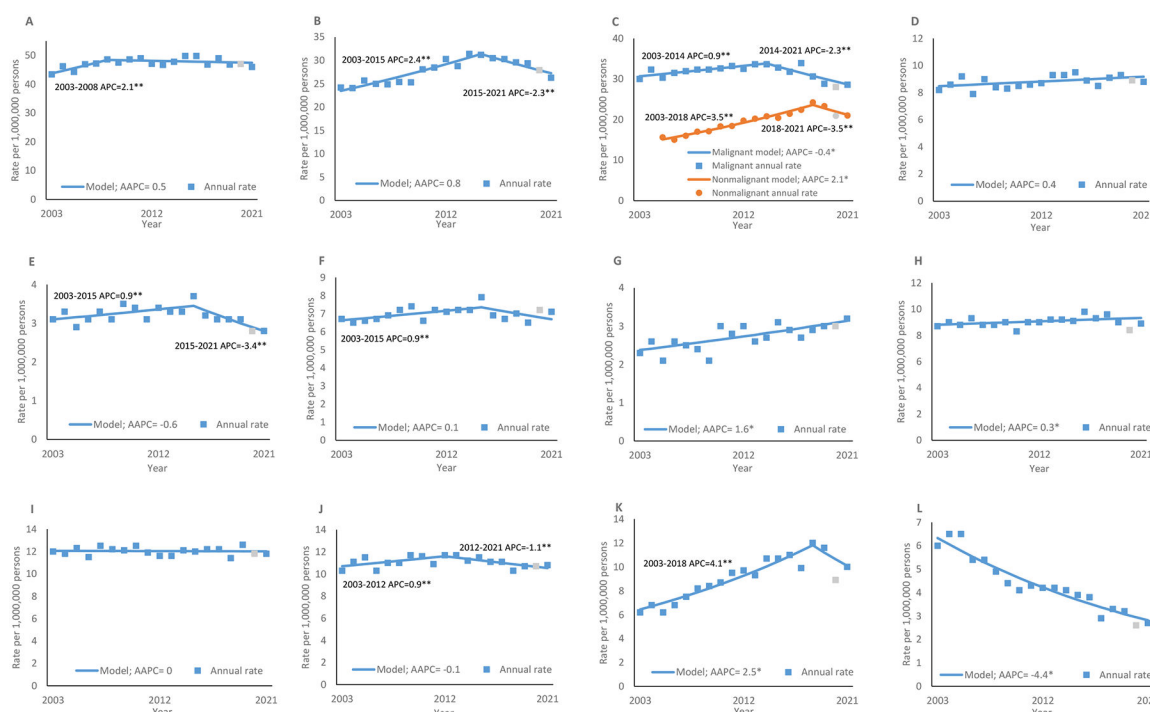
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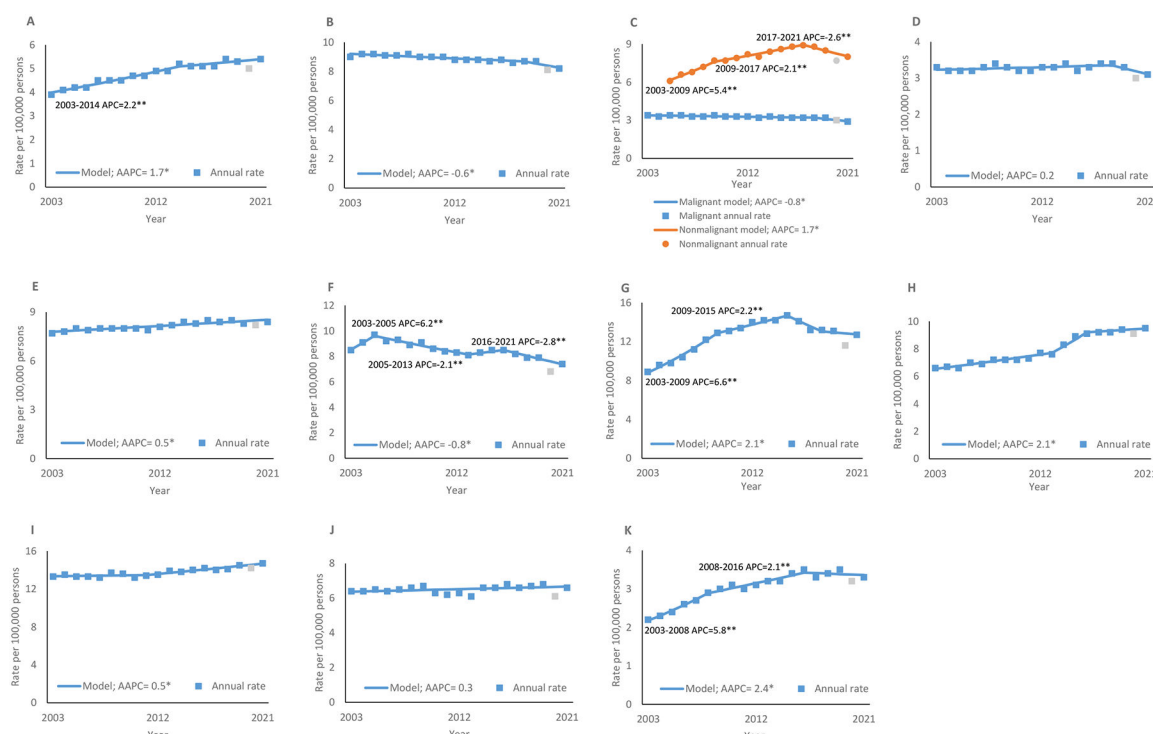
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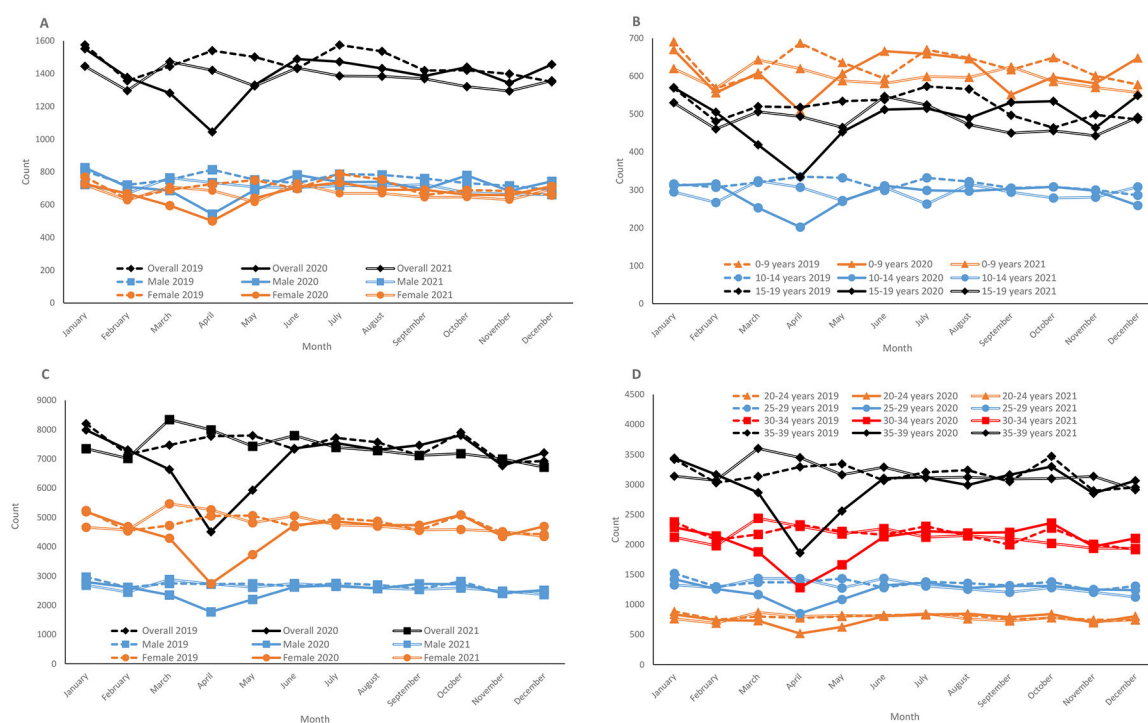
**FIGURE 1.**

Incidence and trends of cancer, ages 0–19 years, 2003 to 2021, US Cancer Statistics.

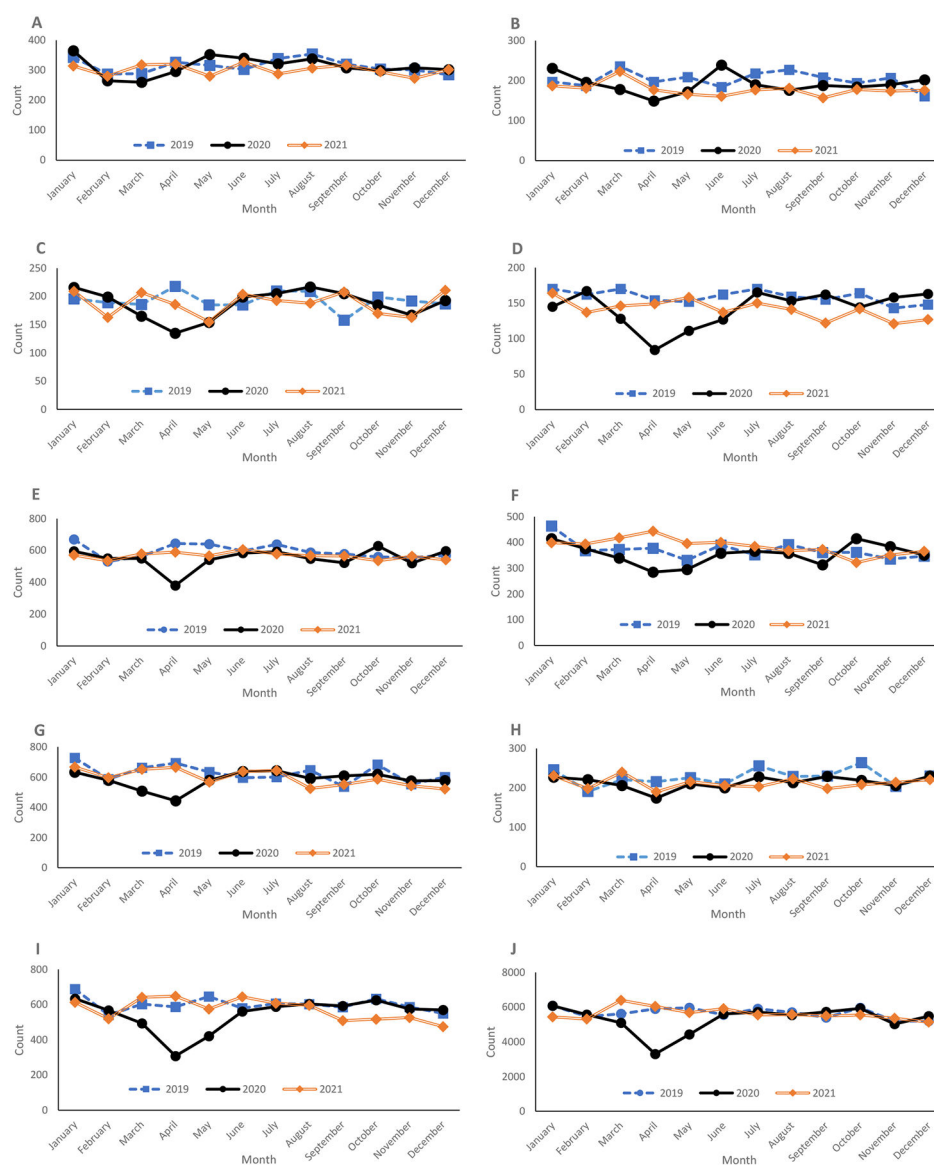
A) I Leukemia, B) II Lymphoma, C) III CNS neoplasms, D) IV Neuroblastoma, E) V Retinoblastoma, F) VI Renal, G) VII Hepatic, H) VIII Bone tumors, I) IX Soft tissue sarcoma, J) X Germ cell, K) XI(b) Thyroid, L) XI(d) Melanoma. Cancer type is grouped according to the International Classification of Childhood Cancer. Includes both malignant and nonmalignant cases unless otherwise stated. Trends were estimated using joinpoint regression and measured with APC or AAPC and were considered to increase or decrease if $p < .05$ (2-sided); otherwise, trends were considered stable. Excludes 2020 in trend analysis. *Indicates significant AAPC at $p < .05$. **Indicates significant APC at $p < .05$. APC, annual percent change; AAPC, average annual percent change; CNS, central nervous system.

**FIGURE 2.**

A) 1. Leukemia, B) 2. Lymphoma, C) 3. CNS neoplasms, D) 4. Sarcomas, E) 7. Gonadal and related tumors, F) 8. Melanoma, G) 9.1 Thyroid carcinoma, H) 9.3 Carcinoma of gastrointestinal tract, I) 9.6. Carcinoma of breast, J) 9.7. Carcinoma of genital sites excluding ovary and testis, K) 9.8 Carcinoma of urinary tract. Incidence and trends of cancer, ages 20–39 years, 2003 to 2021, US Cancer Statistics. Cancer is grouped according to the Adolescent and Young Adult Recode 2020 Revision. Includes both malignant and nonmalignant cases unless otherwise stated. Trends were estimated using joinpoint regression and measured with APC or AAPC and were considered to increase or decrease if $p < .05$ (2-sided); otherwise, trends were considered stable. Excludes 2020 in trend analysis. *Indicates significant AAPC at $p < .05$. **Indicates significant APC at $p < .05$. APC, annual percent change; AAPC, average annual percent change; CNS, central nervous system.

**FIGURE 3.**

New diagnosis cancer counts by month, ages 0–39 years, 2019 to 2021, US Cancer statistics. Includes both malignant and nonmalignant cases. A) Overall and by sex, ages 0–19 years, B) Count by age, ages 0–19 years, C) Overall by sex, ages 20–39 years, D) Count by age, ages 20–39 years.

**FIGURE 4.**

New diagnosis cancer counts by month and cancer type, ages 0–39 years, 2019 to 2021, US Cancer Statistics. A) Leukemia, ages 0–19 years, B) Lymphoma, ages 0–19 years, C) CNS (malignant), ages 0–19 years, D) CNS (nonmalignant), ages 0–19 years, E) Solid tumors, ages 0–19 years, F) Leukemia, ages 20–39 years, G) Lymphoma, ages 20–39 years, H) CNS (malignant), ages 20–39 years, I) CNS (nonmalignant), ages 20–39 years, J) Solid tumors, ages 20–39 years. Cases are defined according to the International Classification of Childhood Cancer for ages 0–19 years and the Adolescent and Young Adult Site Recode 2020 Revision for ages 20–39 years. Solid tumors include all type categories except leukemia, lymphoma, and CNS tumors. Figures include both malignant and nonmalignant cases unless otherwise stated. CNS, central nervous system.

TABLE 1
Cancer incidence rates in ages 0–19 years in US Cancer Statistics, 2019 to 2021.

Characteristic	2019		2020			2021		
	Count	Rate	Count	Rate	IRR (95% CI) ^a	Count	Rate	IRR (95% CI) ^a
Total	17 593	215.3	16 622	205.0	0.95 (0.93–0.97) ^b	16 542	206.8	0.96 (0.94–0.98) ^b
Sex								
Male	9067	217.3	8622	208.1	0.96 (0.93–0.99) ^b	8471	207.4	0.95 (0.93–0.98) ^b
Female	8526	213.3	8000	201.6	0.95 (0.92–0.97) ^b	8071	206.2	0.97 (0.94–1.00) ^b
Age, years								
0–14	11 330	190.2	10 738	181.7	0.96 (0.93–0.98) ^b	10 687	183.1	0.96 (0.94–0.99) ^b
0–4	4682	247.4	4543	243.9	0.99 (0.95–1.03)	4408	241.8	0.98 (0.94–1.02)
<1	1063	292.6	1046	291.3	1.00 (0.91–1.09)	1002	286.9	0.98 (0.90–1.07)
5–9	2875	146.3	2763	140.5	0.96 (0.91–1.01)	2757	140.5	0.96 (0.91–1.01)
10–14	3773	179.5	3432	163.7	0.91 (0.87–0.96) ^b	3522	169.8	0.95 (0.90–0.99) ^b
15–19	6263	290.3	5884	274.2	0.94 (0.91–0.98) ^b	5855	277.4	0.96 (0.92–0.99) ^b
Race and ethnicity^c								
American Indian/Alaska Native	173	220.6	162	209.8	0.95 (0.76–1.19)	170	224.1	1.02 (0.82–1.26)
Asian or Pacific Islander	901	173.9	927	178.7	1.03 (0.94–1.13)	954	185.6	1.07 (0.97–1.17)
Black	2034	163.8	1989	160.7	0.98 (0.92–1.04)	1981	161.5	0.99 (0.93–1.05)
Hispanic	4605	222.3	4260	205.1	0.92 (0.88–0.96) ^b	4355	210.7	0.95 (0.91–0.99) ^b
White	9498	222.9	8952	213.2	0.96 (0.93–0.98) ^b	8687	211.1	0.95 (0.92–0.98) ^b
Stage^d								
Localized	5186	63.6	4727	58.4	0.92 (0.88–0.96) ^b	4662	58.4	0.92 (0.88–0.96) ^b
Regional	2274	27.5	2117	25.8	0.94 (0.88–1.00) ^b	2325	28.8	1.05 (0.99–1.11)
Distant	2223	27.3	2233	27.6	1.01 (0.95–1.07)	2196	27.5	1.01 (0.95–1.07)
Unknown	611	7.5	477	5.9	0.79 (0.70–0.89) ^b	422	5.3	0.70 (0.62–0.80) ^b
Region								
Northeast	3116	227.7	2930	216.9	0.95 (0.91–1.00)	3025	227.6	1.00 (0.95–1.05)
Midwest	3371	213.2	3105	197.8	0.93 (0.88–0.97) ^b	3064	199.2	0.93 (0.89–0.98) ^b
South	6901	214.1	6505	202.6	0.95 (0.91–0.98) ^b	6495	203.4	0.95 (0.92–0.98) ^b
West	4205	210.5	4082	206.3	0.98 (0.94–1.02)	3958	204.3	0.97 (0.93–1.01)
Metropolitan status								
Metropolitan counties	15 337	217.0	14 448	205.8	0.95 (0.93–0.97) ^b	14 360	207.5	0.96 (0.93–0.98) ^b
Nonmetropolitan counties	2247	203.9	2171	199.5	0.98 (0.92–1.04)	2174	201.5	0.99 (0.93–1.05)
Cancer type								
ICCC (malignant)								
I Leukemias, myeloproliferative and myelodysplastic diseases	3776	46.8	3757	47.0	1.00 (0.96–1.05)	3633	46.0	0.98 (0.94–1.03)
II Lymphomas and reticuloendothelial neoplasms	2427	29.4	2295	27.9	0.95 (0.90–1.01)	2141	26.3	0.90 (0.85–0.95) ^b

Characteristic	2019		2020			2021		
	Count	Rate	Count	Rate	IRR (95% CI) ^a	Count	Rate	IRR (95% CI) ^a
III CNS and misc intracranial and intraspinal neoplasms	2318	28.8	2240	28.0	0.97 (0.92–1.03)	2261	28.6	0.99 (0.94–1.05)
IV Neuroblastoma and other peripheral nervous cell tumors	728	9.3	688	8.9	0.96 (0.86–1.07)	672	8.8	0.95 (0.86–1.06)
V Retinoblastoma	239	3.1	216	2.8	0.92 (0.76–1.11)	210	2.8	0.91 (0.75–1.10)
VI Renal tumors	515	6.5	561	7.2	1.10 (0.98–1.24)	546	7.1	1.09 (0.96–1.23)
VII Hepatic tumors	238	3.0	233	3.0	0.99 (0.82–1.19)	248	3.2	1.07 (0.89–1.29)
VIII Malignant bone tumors	748	9.0	696	8.4	0.93 (0.84–1.03)	731	8.9	0.99 (0.89–1.10)
IX Soft tissue and other extraosseous sarcomas	1033	12.6	960	11.8	0.94 (0.86–1.02)	939	11.8	0.93 (0.85–1.02)
X Germ cell and trophoblastic tumors and neoplasms of gonads	889	10.7	888	10.7	1.00 (0.91–1.10)	884	10.8	1.02 (0.92–1.12)
XI Other malignant epithelial neoplasms and melanomas	2074	24.6	1709	20.3	0.83 (0.78–0.88) ^b	1888	22.8	0.93 (0.87–0.99) ^b
XI(b) Thyroid carcinomas	980	11.6	753	8.9	0.77 (0.70–0.85) ^b	830	10.0	0.86 (0.79–0.95) ^b
XI(d) Malignant melanomas	264	3.2	218	2.6	0.82 (0.69–0.99) ^b	224	2.7	0.86 (0.72–1.04)
XII Other and unspecified malignant neoplasms	67	0.8	77	1.0	1.15 (0.82–1.63)	96	1.2	1.46 (1.06–2.03) ^b
Not classified by ICCC or in situ	41	0.5	40	0.5	0.98 (0.62–1.55)	47	0.6	1.18 (0.76–1.85)
ICCC (Nonmalignant) ^e								
III CNS and misc intracranial and intraspinal neoplasms	1924	23.3	1713	20.9	0.89 (0.84–0.96) ^b	1701	21.0	0.90 (0.84–0.96) ^b
X Germ cell and trophoblastic tumors and neoplasms of gonads	41	0.5	28	0.4	0.68 (0.41–1.14)	35	0.4	0.86 (0.53–1.38)
Not classified by ICCC or in situ	497	6.0	484	5.9	0.98 (0.86–1.11)	478	5.9	0.99 (0.87–1.13)

Rates are per 1,000,000 and age-adjusted to the 2000 US Std Population (19 age groups - Census P25–1130) standard; confidence intervals (Tiwari mod) are 95% for ratios. Includes malignant and nonmalignant cases unless otherwise specified. CI, confidence interval; CNS, central nervous system; ICCC, International Classification of Childhood Cancer; IRR, incidence rate ratio; misc, miscellaneous.

^aCompared to 2019.

^bDifference was significant at $p < .05$ (2-sided).

^cRace and ethnicity was categorized as Non-Hispanic American Indian or Alaska Native, Non-Hispanic Asian or Pacific Islander, Non-Hispanic Black (Black), Non-Hispanic White (White), and Hispanic or Latino (Hispanic). Excludes 382 non-Hispanic unknown race cases in 2019, 332 in 2020, and 395 in 2021.

^dMalignant cases only. Excludes ICCC groups I, X, and XII. Excludes 24 blank stage cases in 2019, 42 in 2020, and 30 in 2021.

^eExcludes 84 soft tissue (ICCC group IX) nonmalignant cases.

TABLE 2
Cancer incidence rates in ages 20–39 years in US Cancer Statistics, 2019 to 2021.

Characteristic	2019		2020			2021		
	Count	Rate	Count	Rate	IRR (95% CI) ^a	Count	Rate	IRR (95% CI) ^a
Total	90 184	107.2	84 058	99.5	0.93 (0.92–0.94) ^b	88 871	104.9	0.98 (0.97–0.99) ^b
Sex								
Male	32 263	74.6	30 057	69.1	0.93 (0.91–0.94) ^b	31 376	72.0	0.97 (0.95–0.98) ^b
Female	57 921	140.8	54 001	130.8	0.93 (0.92–0.94) ^b	57 495	138.9	0.99 (0.98–1.00) ^b
Age, years								
20–24	9552	44.4	9096	42.1	0.95 (0.92–0.98) ^b	9354	42.5	0.96 (0.93–0.98) ^b
25–29	16 299	72.0	14 896	66.8	0.93 (0.91–0.95) ^b	15 624	71.2	0.99 (0.97–1.01)
30–34	26 090	118.4	24 498	109.6	0.93 (0.91–0.94) ^b	25 629	113.4	0.96 (0.94–0.97) ^b
35–39	38 243	176.9	35 568	163.9	0.93 (0.91–0.94) ^b	38 264	175.7	0.99 (0.98–1.01)
Race and ethnicity^c								
American Indian/Alaska Native	829	114.6	760	103.0	0.90 (0.81–0.99) ^b	801	106.6	0.93 (0.84–1.03)
Asian or Pacific Islander	5274	79.9	4768	71.5	0.89 (0.86–0.93) ^b	5423	80.9	1.01 (0.98–1.05)
Black	10 376	88.4	9788	82.6	0.93 (0.91–0.96) ^b	10 296	86.0	0.97 (0.95–1.00) ^b
Hispanic	16 272	90.8	15 536	86.1	0.95 (0.93–0.97) ^b	16 908	92.9	1.02 (1.00–1.05) ^b
White	55 163	117.0	51 051	108.3	0.93 (0.91–0.94) ^b	52 885	112.4	0.96 (0.95–0.97) ^b
Stage^d								
Localized	33 135	39.6	30 031	35.7	0.90 (0.89–0.92) ^b	31 996	38.0	0.96 (0.95–0.98) ^b
Regional	17 626	21.1	17 040	20.3	0.96 (0.94–0.98) ^b	17 900	21.2	1.01 (0.99–1.03)
Distant	8578	10.2	8374	10.0	0.97 (0.94–1.00)	8538	10.1	0.99 (0.96–1.02)
Unknown	3302	3.9	2862	3.4	0.86 (0.82–0.91) ^b	2801	3.3	0.84 (0.80–0.89) ^b
Region								
Northeast	17 030	116.1	15 206	103.3	0.89 (0.87–0.91) ^b	16 603	113.5	0.98 (0.96–1.00) ^b
Midwest	17 414	111.5	16 317	104.6	0.94 (0.92–0.96) ^b	17 196	110.4	0.99 (0.97–1.01)
South	34 100	105.4	32 248	99.2	0.94 (0.93–0.96) ^b	34 101	103.9	0.99 (0.97–1.00)
West	21 640	100.6	20 287	93.6	0.93 (0.91–0.95) ^b	20 971	96.7	0.96 (0.94–0.98) ^b
Metropolitan status								
Metropolitan counties	79 421	107.3	73 706	99.1	0.92 (0.91–0.93) ^b	78 153	104.8	0.98 (0.97–0.99) ^b
Nonmetropolitan counties	10 719	106.0	10 313	102.1	0.96 (0.94–0.99) ^b	10 690	105.5	0.99 (0.97–1.02)
Cancer type^e								
Malignant								
1. Leukemias and related disorders	4495	5.3	4291	5.0	0.95 (0.91–0.99) ^b	4642	5.4	1.02 (0.98–1.06)
2. Lymphomas	7533	8.7	7002	8.1	0.93 (0.90–0.96) ^b	7167	8.2	0.94 (0.91–0.98) ^b
3. CNS and other intracranial and intraspinal neoplasms	2736	3.2	2566	3.0	0.94 (0.89–0.99) ^b	2551	2.9	0.93 (0.88–0.98) ^b

Characteristic	2019		2020			2021		
	Count	Rate	Count	Rate	IRR (95% CI) ^a	Count	Rate	IRR (95% CI) ^a
4. Sarcomas	2806	3.3	2626	3.0	0.93 (0.88–0.98) ^b	2648	3.1	0.94 (0.89–0.99) ^b
5. Blood and lymphatic vessel tumors	468	0.5	459	0.5	0.99 (0.86–1.12)	528	0.6	1.12 (0.99–1.28)
6. Nerve sheath tumors	139	0.2	164	0.2	1.21 (0.96–1.53)	146	0.2	1.07 (0.84–1.36)
7. Gonadal and related tumors	7282	8.3	7224	8.2	0.99 (0.96–1.02)	7371	8.4	1.01 (0.98–1.04)
8. Melanoma—malignant	6665	7.9	5690	6.8	0.85 (0.82–0.88) ^b	6253	7.4	0.93 (0.90–0.97) ^b
9. Carcinomas	42 312	51.1	39 820	47.9	0.94 (0.92–0.95) ^b	41 969	50.3	0.99 (0.97–1.00) ^b
9.1 Thyroid carcinoma	11 184	13.1	9985	11.6	0.89 (0.87–0.91) ^b	10 908	12.7	0.97 (0.94–0.99) ^b
9.2 Other carcinoma of head and neck	1589	1.9	1487	1.8	0.93 (0.87–1.00) ^b	1486	1.8	0.93 (0.87–1.00) ^b
9.3 Carcinoma of gastrointestinal tract	7753	9.4	7602	9.1	0.98 (0.94–1.01)	7891	9.5	1.01 (0.98–1.04)
9.4 Carcinoma of lung, bronchus, and trachea	991	1.2	894	1.1	0.90 (0.82–0.98) ^b	857	1.0	0.86 (0.78–0.94) ^b
9.5 Carcinoma of skin (if collected)	93	0.1	70	0.1	0.73 (0.53–1.01)	69	0.1	0.74 (0.53–1.02)
9.6 Carcinoma of breast	11 769	14.5	11 588	14.2	0.98 (0.95–1.00)	12 004	14.7	1.01 (0.98–1.04)
9.7 Carcinoma of genital sites excluding ovary and testis	5641	6.8	5062	6.1	0.89 (0.86–0.93) ^b	5443	6.6	0.96 (0.93–1.00) ^b
9.8 Carcinoma of urinary tract	2843	3.5	2591	3.2	0.91 (0.86–0.96) ^b	2758	3.3	0.96 (0.91–1.02)
9.9 Other invasive carcinomas	449	0.5	541	0.6	1.19 (1.04–1.35) ^b	553	0.7	1.22 (1.07–1.38) ^b
10. Miscellaneous specified neoplasms	248	0.3	250	0.3	1.01 (0.84–1.21)	408	0.5	1.62 (1.38–1.91) ^b
11. Unspecified malignant neoplasms except CNS	631	0.8	625	0.7	0.99 (0.88–1.11)	704	0.8	1.10 (0.99–1.23)
A. In situ	386	0.5	347	0.4	0.87 (0.75–1.01)	416	0.5	1.06 (0.92–1.23)
Nonmalignant								
3. CNS and other intracranial and intraspinal neoplasms	7283	8.5	6584	7.7	0.90 (0.87–0.93) ^b	6921	8.0	0.94 (0.91–0.97) ^b
5. Blood and lymphatic vessel tumors	426	0.5	393	0.5	0.92 (0.80–1.06)	347	0.4	0.81 (0.70–0.93) ^b
6. Nerve sheath tumors	1000	1.2	926	1.1	0.91 (0.83–1.00)	966	1.1	0.95 (0.87–1.04)
A. In situ	5740	7.0	5067	6.1	0.88 (0.84–0.91) ^b	5818	7.0	1.01 (0.97–1.05)

Rates are per 100,000 and age-adjusted to the 2000 US Std Population (19 age groups - Census P25–1130) standard; confidence intervals (Tiwari mod) are 95% for ratios. Includes malignant and nonmalignant cases unless otherwise specified. CI, confidence interval; CNS, central nervous system; IRR, incidence rate ratio.

^aCompared to 2019.

^bDifference was significant at $p < .05$ (2-sided).

^cRace and ethnicity was categorized as Non-Hispanic American Indian or Alaska Native, Non-Hispanic Asian or Pacific Islander, Non-Hispanic Black (Black), Non-Hispanic White (White), and Hispanic or Latino (Hispanic). Excludes 382 non-Hispanic unknown race cases in 2019, 332 in 2020, and 395 in 2021.

^dMalignant cases only. Includes Adolescent and Young Adult Site Recode 2020 Revision groups 2 through 9, excluding 7. Excludes 7 blank stage cases in 2019, 12 in 2020, and 9 in 2021.

^eClassified by Adolescent and Young Adult Recode 2020 Revision. Excludes 5 unclassified malignant cases and 58 gonadal and related tumor nonmalignant cases.