Department of Health

Child and Adolescent Cancer in Ohio 2024

August 2024

Introduction

Cancer is a group of diseases characterized by uncontrolled growth and spread of abnormal cells. If the spread is not controlled, it can result in death. In 2024, an estimated 9,620 children (ages 0 to 14 years) and 5,290 adolescents (ages 15-19 years) in the United States will be diagnosed with cancer, and about 1,040 children and 550 adolescents will die from the disease.[1] Cancer is the leading disease-related cause of death among both children and adolescents.[1]

In this document, child and adolescent cancer is defined as newly diagnosed, malignant, invasive neoplasms (tumors) among persons 0-19 years old. The rates in this document are presented as the number of cases per 1,000,000 children and adolescents, whereas rates for adults are typically reported as the number of cases per 100,000 population.

The types of cancer that develop in children and adolescents differ from those that develop in adults. Overall, among children and adolescents (ages 0 to 19) in the United States, the most common types of cancer are leukemias, brain and central nervous system (CNS) cancer, and lymphomas. Page 2 shows a list of the most common types of cancer in children and adolescents.

[1.] American Cancer Society. Cancer Facts & Figures 2024. Atlanta: American Cancer Society; 2024.

Key Findings

- An average of 552 new invasive cancer cases and 58 cancer deaths occurred each year among children and adolescents in Ohio during 2017-2021.
- Child and adolescent cancer incidence and mortality rates were greater for males, White people, and those 15-19 years old in both Ohio and the United States.
- In Ohio, the leading cancer types among children were leukemias (27%), brain and other CNS cancer (20%), and lymphomas (12%).
- The leading cancer types among adolescents in Ohio were lymphomas (21%), thyroid cancer (14%), and leukemias (14%).
- Appalachian counties had a higher overall child and adolescent cancer incidence rate than non-Appalachian counties, but the difference was not statistically significant.
- Overall, cancer incidence rates increased among children and adolescents in Ohio and the United States, while mortality rates declined from 2000 to 2021.
- There are few known causes of childhood cancer. Most cancers in children, like those in adults, are thought to develop because of mutations in genes that lead to uncontrolled cell growth and eventually cancer. Specific chromosomes, certain genetic syndromes, and ionizing radiation explain a small percentage of cases among children and adolescents.
- Signs and symptoms of child and adolescent cancer are similar to other common conditions in this age group, making early diagnosis difficult.
- Relative survival among child and adolescent cancer patients improved from 71.7% in 1996 to 90.2% in 2016.

Common Cancer Types Among Children and Adolescents

The common types of cancer that develop in children and adolescents, in alphabetical order, include:

Bone tumors: Cancer that forms in cells of the bone. The most common types of bone cancer in children are osteosarcoma and Ewing sarcoma.

Brain and other CNS cancer: The growth of abnormal cells in the tissues of the brain and other CNS. The most common types of brain and other CNS tumors in children are medulloblastoma, astrocytoma, ependymoma, and brain stem glioma.

Germ cell tumors: A type of tumor that begins in the cells that give rise to sperm or eggs. Germ cell tumors can occur almost anywhere in the body and can be either benign (non-cancerous) or malignant (cancerous).

Hepatic (liver) tumors: Cancer that forms in the tissues of the liver.

Leukemias: Cancer that originates in the bone marrow and causes large numbers of abnormal blood cells, particularly white blood cells, to be produced and enter the bloodstream. The two major types of leukemia in children and adolescents are:

- **Lymphocytic leukemia**: Cancer of blood-forming cells arising in the bone marrow that starts from lymphocytes. Lymphocytic leukemia may be acute and develop quickly or chronic and develop slowly. In the United States, acute lymphocytic leukemia (ALL) accounts for about 75% of the leukemia cases among children and adolescents.
- **Acute myeloid leukemia**: Cancer of blood-forming cells arising in the bone marrow that starts from myeloid cells and grows quickly. Nationally, acute myeloid leukemia (AML) accounts for about 17% of leukemia cases among children and adolescents.

Lymphomas: Cancer that begins in the cells of the immune system. There are two basic categories of lymphoma:

- **Hodgkin lymphoma**: Cancer of the lymphatic system that is marked by the presence of a type of cell called the Reed–Sternberg cell. Hodgkin lymphoma often starts in the lymph nodes in the chest, neck, or abdomen. Hodgkin lymphoma is rare in children but increases rapidly from age 10 through adolescence.
- **Non-Hodgkin lymphoma**: Cancer of the lymphatic system, excluding Hodgkin lymphoma. The most common types of non-Hodgkin lymphoma in children are Burkitt lymphoma, lymphoblastic lymphoma, and large cell lymphoma.

Melanomas: Cancer that begins in melanocytes (cells that make the pigment melanin). It may begin in a mole (skin melanoma), but can also begin in other pigmented tissues, such as in the eye or in the intestines.

Neuroblastomas: Cancer that arises in immature nerve cells and affects mostly infants and children.

Renal tumors: Cancer of the kidney. The vast majority of kidney tumors in children are Wilms tumor.

Retinoblastomas: Cancer that forms in the tissues of the retina (the light-sensitive layers of nerve tissue at the back of the eye).

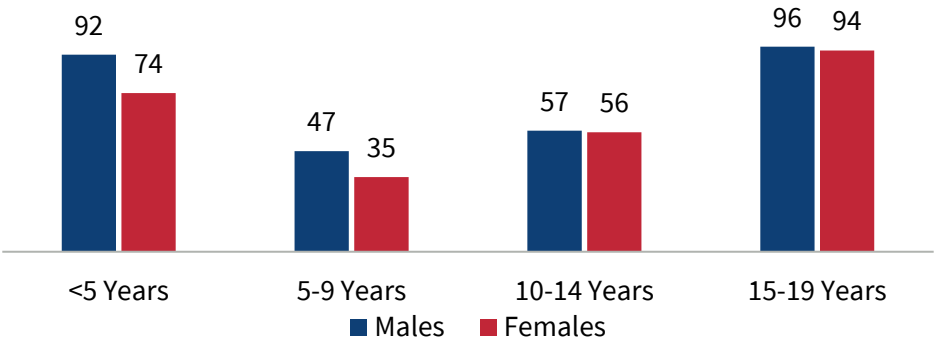
Soft tissue sarcomas: Cancer that begins in the muscle, fat, fibrous tissue, blood vessels, or other supporting tissues of the body. The most common soft tissue sarcoma is rhabdomyosarcoma.

Thyroid carcinomas: Cancer that forms in the thyroid gland.

Cancer by Age Group Among Children and Adolescents

The frequency of cancer diagnoses varied by age group, with cancers occurring most frequently among adolescents ages 15-19, followed by children ages <5 years, 10-14, and 5-9, respectively. Males were diagnosed with more cancers across all age groups (Figure 1).

Figure 1. Average Annual Number of New Invasive Cancer Cases Among Children and Adolescents (Ages 0-19) by Age Group, Ohio, 2017-2021

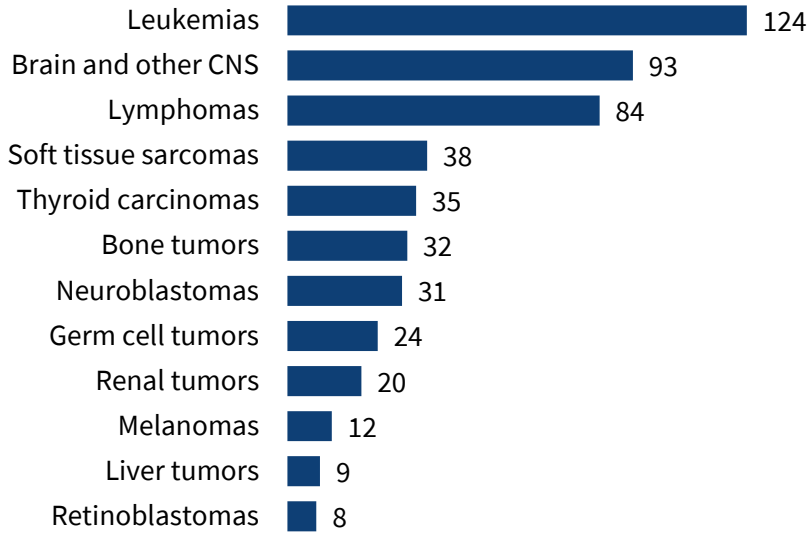


Source: Ohio Cancer Incidence Surveillance System, Ohio Department of Health, 2024.

Number of Cancers by Type Among Children and Adolescents

Overall, leukemias were the most frequently diagnosed cancer among children and adolescents in Ohio during 2017-2021, accounting for an average of 124 cases per year. During the same years, brain and other CNS cancers (93 cases per year) and lymphomas (84 cases per year) were the second and third most commonly diagnosed cancers among children and adolescents in Ohio, respectively (Figure 2).

Figure 2. Average Annual Number of New Invasive Cancer Cases by ICCC* Groupings Among Children and Adolescents (Ages 0-19), Ohio, 2017-2021



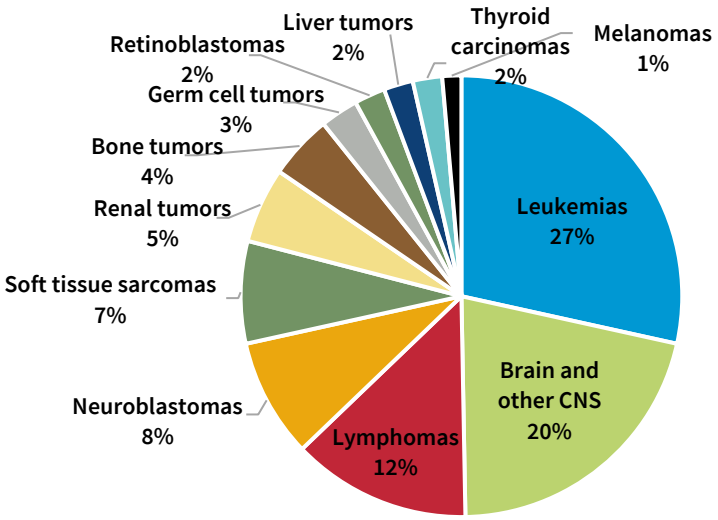
Source: Ohio Cancer Incidence Surveillance System, Ohio Department of Health, 2024, based on malignant behavior.
* ICCC = International Classification of Childhood Cancer.

Leading Cancer Types Among Children and Adolescents

Figures 3 and 4 show the proportion of new invasive cancer cases among children and adolescents, respectively, in Ohio from 2017-2021 for the leading types of cancer in these age groups.

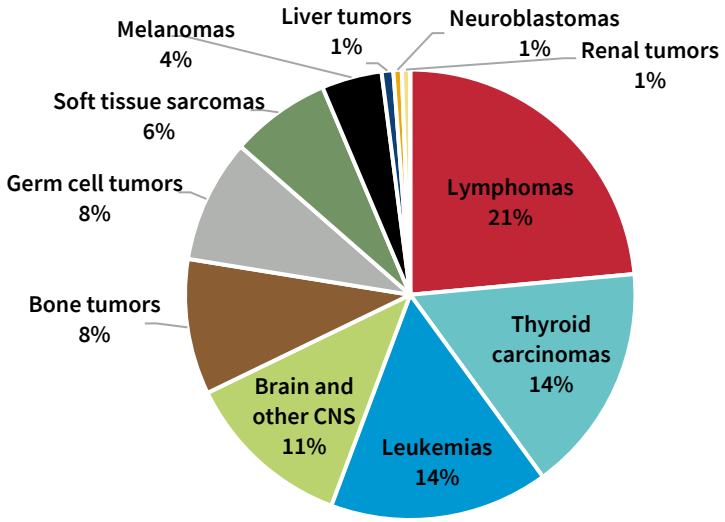
- Among children, the leading cancer types included leukemias (98 cases per year) and brain and other CNS cancers (73 cases per year), accounting for 27% and 20% of newly diagnosed cases, respectively.
- Among adolescents, lymphomas were the leading cancer (39 cases per year, 21%), followed by thyroid carcinomas (27 cases per year, 14%), leukemias (26 cases per year, 14%) and brain and other CNS cancers (20 cases per year, 11%).

Figure 3. Proportion (%) of New Invasive Cancer Cases Among Children (Ages 0-14), Ohio, 2017-2021



Source: Ohio Cancer Incidence Surveillance System, Ohio Department of Health, 2024.

Figure 4. Proportion (%) of New Invasive Cancer Cases Among Adolescents (Ages 15-19), Ohio, 2017-2021



Source: Ohio Cancer Incidence Surveillance System, Ohio Department of Health, 2024.

Risk of Cancer Among Children and Adolescents

In the United States, one in 255 males and one in 273 females will be diagnosed with cancer by age 20. The risk varies depending on the cancer type (Table 1).

Table 1. Risk of Being Diagnosed with Cancer by Age 20 for Selected Types by Sex, United States, 2018-2021 (2020 Excluded)

	Male	Female
All Malignant Cancers	**1 in 255**	**1 in 273**
Brain and Other CNS	1 in 1,667	1 in 1,786
Hodgkin Lymphoma	1 in 4,000	1 in 4,348
Non-Hodgkin Lymphoma	1 in 3,125	1 in 5,882
Leukemias	1 in 962	1 in 1,205

Source: DevCan: Probability of Developing or Dying of Cancer Software, Version 6.9.1. Surveillance Research Program, Statistical Methodology and Applications Branch, National Cancer Institute, 2024. https://surveillance.cancer.gov/devcan/canques.html. Risk of developing cancer by age 20 for those free of cancer at birth, based on cancer cases diagnosed during 2018-2021 (excluding 2020) in the Surveillance, Epidemiology, and End Results (SEER) Program 22 registries. Numbers are rounded to the nearest whole person.

Cancer Incidence and Mortality Among Children and Adolescents

During 2017-2021, an average of 552 new invasive cancer cases and 58 cancer deaths occurred each year among children and adolescents in Ohio (Table 2). The average annual age-adjusted incidence rate in Ohio was 187.6 cases per 1,000,000 children and adolescents, similar to the U.S. (Surveillance, Epidemiology, and End Results [SEER] Program) incidence rate of 187.9 per 1,000,000. The Ohio child and adolescent cancer mortality rate of 19.7 deaths per 1,000,000 during 2017-2021 was slightly lower than the U.S. mortality rate of 21.1 per 1,000,000. In both Ohio and the United States, cancer incidence and mortality rates were higher among White children and adolescents, compared with Black, Asian/Pacific Islander (A/PI), and Hispanic children and adolescents, and those 15 to 19 years old, compared with those 0 to 14 years old.

Table 2. Average Annual Number of New Invasive Cancer Cases and Age-Adjusted Incidence Rates and Average Annual Number of Cancer Deaths and Age-Adjusted Mortality Rates Among Children and Adolescents (Ages 0-19) by Sex, Race, Ethnicity, and Age Group, Ohio and the United States, 2017-2021

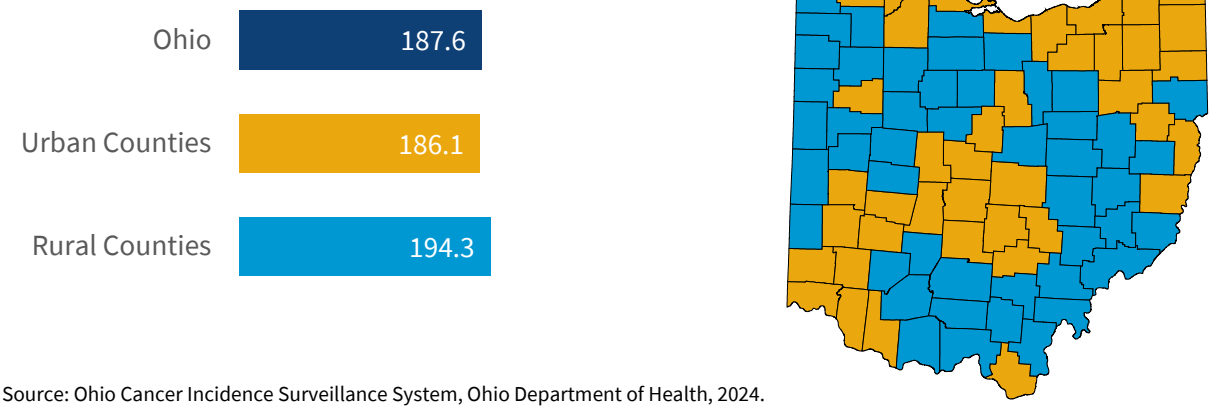
		Incidence			Mortality		
		Ohio		U.S.	Ohio		U.S.
		Cases	Rate	Rate	Deaths	Rate	Rate
	Total	**552**	**187.6**	**187.9**	**58**	**19.7**	**21.1**
Sex	Males	293	194.4	195.6	34	22.7	23.2
	Females	260	180.4	179.9	24	16.5	18.9
Race/Ethnicity	White	450	195.1	196.6	47	20.3	21.6
	Black	71	132.5	140.2	10	19.0	21.2
	A/PI	13	140.3	159.7	*	*	17.8
	Hispanic	20	105.1	188.1	3	15.6	22.2
Age Group	0-14	362	168.6	171.4	40	18.4	19.2
	15-19	191	243.9	236.8	18	23.5	26.6

Source: Ohio Cancer Incidence Surveillance System, Ohio Department of Health, 2024; Surveillance, Epidemiology and End Results (SEER) Program, National Cancer Institute, 2024; U.S. Mortality Files, National Center for Health Statistics, Centers for Disease Control and Prevention, 2024. SEER*Stat 8.4.3 software. Rates are per 1,000,000 and age-adjusted to the 2000 U.S. standard population. * Statistic not displayed due to fewer than 10 deaths in 2017-2021.

Cancer by County Type Among Children and Adolescents

Figure 5 shows the difference in rates between urban (metropolitan) counties and rural (non-metropolitan) counties in Ohio, based on the 2023 Rural-Urban Continuum Codes (see map at right). Rural counties had a higher overall child and adolescent cancer incidence rate, 194.3 (95% confidence interval: 178.0-211.6) per 1,000,000 children and adolescents than urban counties, 186.1 (178.4-194.0) per 1,000,000, but the difference was not statistically significant.*

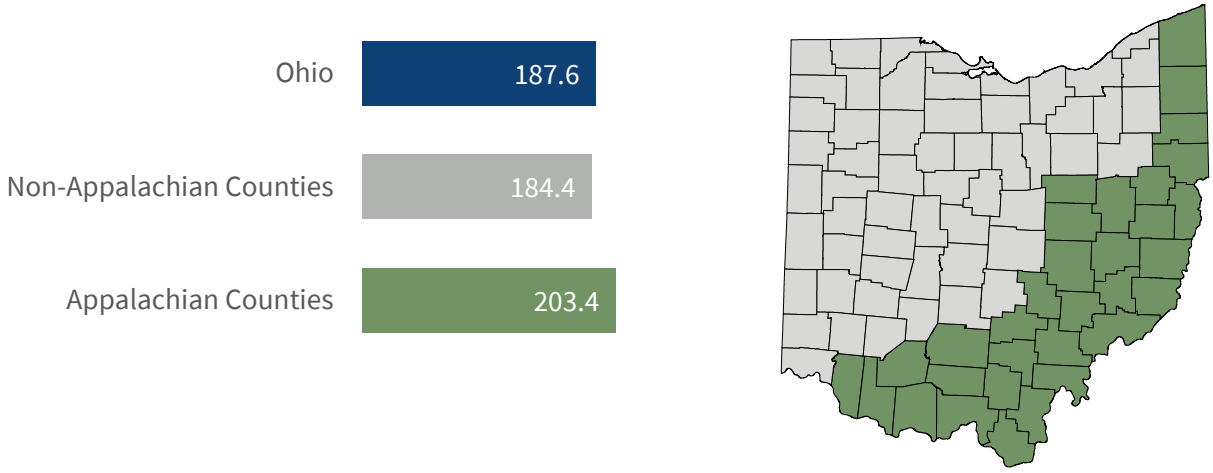
Figure 5. Cancer Incidence Rates Among Children and Adolescents (Ages 0-19) in Urban and Rural Counties, Ohio, 2017-2021



Source: Ohio Cancer Incidence Surveillance System, Ohio Department of Health, 2024.
Rates are per 1,000,000 and age-adjusted to the 2000 U.S. standard population.
* Significant difference between urban and rural counties was determined by comparing 95% confidence intervals (CIs). If the 95% CIs overlap, then there is no significant difference.

Appalachian counties had a higher overall child and adolescent cancer incidence rate, 203.4 (185.8-222.3) per 1,000,000 children and adolescents than non-Appalachian counties, 184.4 (176.9-192.2) per 1,000,000, but the difference was not statistically significant (Figure 6).

Figure 6. Cancer Incidence Rates Among Children and Adolescents (Ages 0-19) in Appalachian and Non-Appalachian Counties, Ohio 2017-2021

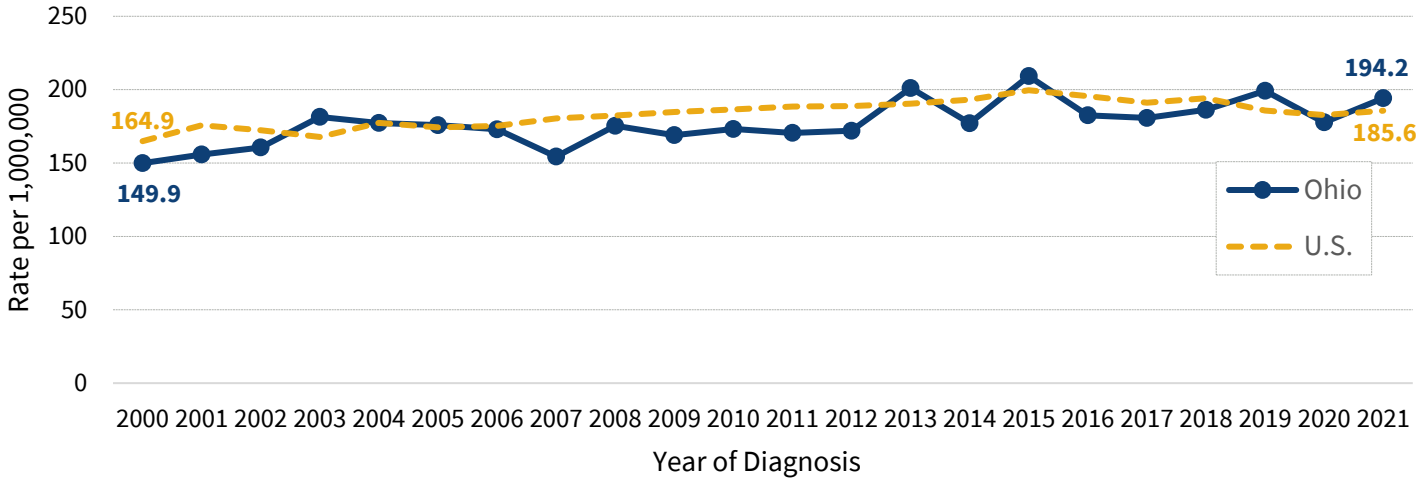


Source: Ohio Cancer Incidence Surveillance System, Ohio Department of Health, 2024.
Rates are per 1,000,000 and age-adjusted to the 2000 U.S. standard population.
* Significant difference between Appalachian and non-Appalachian counties determined by comparing 95% confidence intervals (CIs). If the 95% CIs overlap, then there is no significant difference.

Trends in Cancer Among Children and Adolescents

Ohio child and adolescent cancer incidence rates have increased from 149.9 per 1,000,000 children and adolescents in 2000 to 194.2 per 1,000,000 in 2021 and mirror national trends based on SEER data (Figure 7).

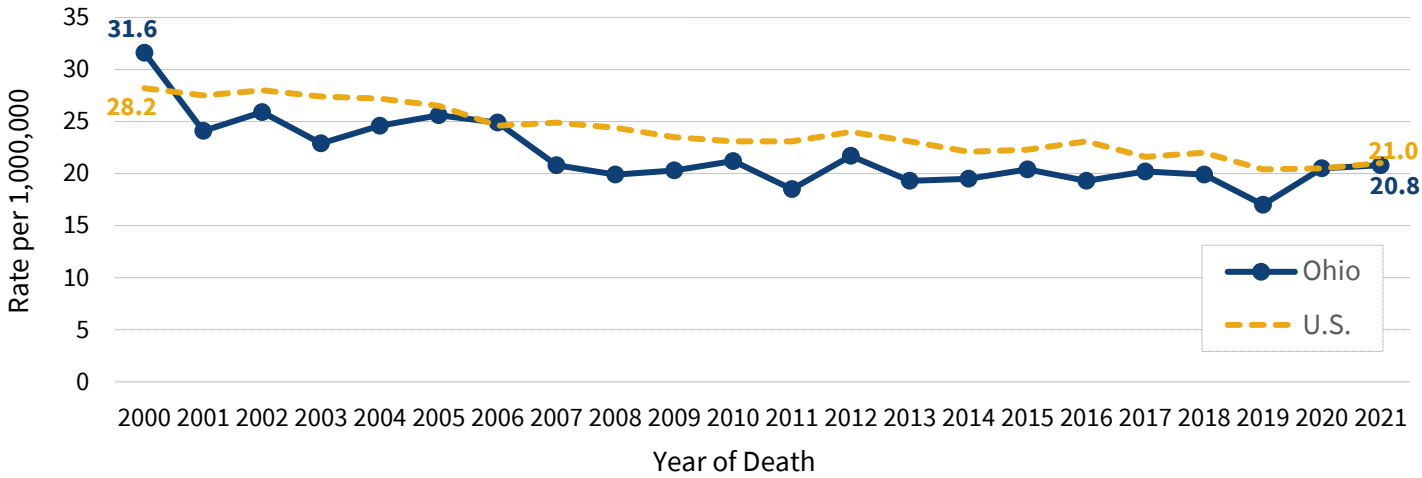
Figure 7. Trends in Cancer Incidence Rates Among Children and Adolescents (Ages 0-19), Ohio and the United States, 2000-2021



Source: Ohio Cancer Incidence Surveillance System, Ohio Department of Health, 2024; Surveillance, Epidemiology, and End Results (SEER) Program, SEER Research Limited-Field Data, 22 Registries, Nov. 2023 Submission (2000-2021), National Cancer Institute, 2024. Software: SEER*Stat version 8.4.3.
Rates are per 1,000,000 and age-adjusted to the 2000 U.S. standard population.

Mortality rates of all child and adolescent cancers combined decreased in Ohio from 31.6 per 1,000,000 children and adolescents in 2000 to 20.8 per 1,000,000 in 2021. During this period, Ohio's cancer mortality rate was highest in 2000 (31.6 per 1,000,000) and fell to a low of 17.0 per 1,000,000 in 2019 (Figure 8).

Figure 8. Trends in Cancer Mortality Rates Among Children and Adolescents (Ages 0-19), Ohio and the United States, 2000-2021



Source: Mortality - All Cause of Death, Aggregated With State, Total U.S. (1990-2022) <Katrina/Rita Population Adjustment> (SEER*Stat Database), 2024.
Underlying mortality data provided by National Center for Health Statistics (www.cdc.gov/nchs). Software: SEER*Stat version 8.4.3.
Rates are per 1,000,000 and age-adjusted to the 2000 U.S. standard population.

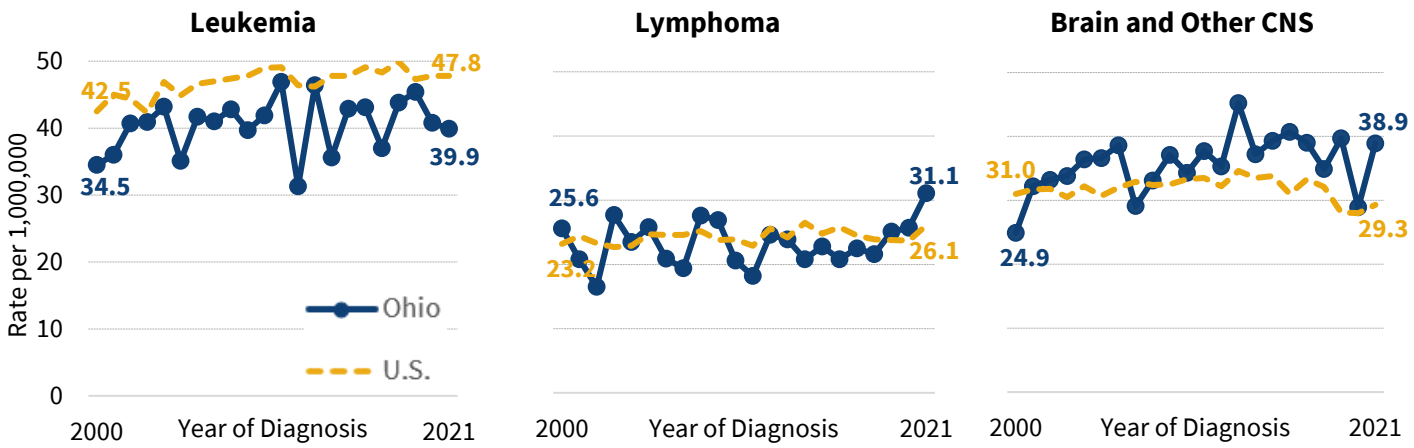
Trends for the Leading Cancers Among Children and Adolescents

Leukemia: Child and adolescent leukemia rates were variable* in Ohio and increased from 34.5 per 1,000,000 children and adolescents in 2000 to 39.9 per 1,000,000 in 2021. Nationally, age-adjusted rates for new child and adolescent leukemia cases have been rising on average 0.7% each year from 2012 to 2021, based on SEER data.

Lymphoma: Incidence rates of lymphoma (including Hodgkin, non-Hodgkin, and other lymphomas) were variable among Ohio children and adolescents and relatively stable nationally from 2000 to 2021.

Brain and Other CNS Cancer: Incidence rates for brain and other CNS cancers were variable in Ohio among children and adolescents. Nationally, age-adjusted rates for new child and adolescent brain and other CNS cancer have not changed significantly from 2012 to 2021 (Figure 9).

Figure 9. Trends in Leukemia, Lymphoma, and Brain and Other CNS Cancer Incidence Rates Among Children and Adolescents (Ages 0-19), Ohio and the United States, 2000-2021



Source: Ohio Cancer Incidence Surveillance System, Ohio Department of Health, 2024; Surveillance, Epidemiology, and End Results (SEER) Program, SEER Research Limited-Field Data, 22 Registries, Nov. 2023 Submission (2000-2021), National Cancer Institute, 2024. Software: SEER*Stat version 8.4.3.
Rates are per 1,000,000 and age-adjusted to the 2000 U.S. standard population.
*Rates at the state level for rare cancers, such as pediatric cancers, are often variable due to small numbers of cases.

Nonmalignant Brain and Other CNS Tumors

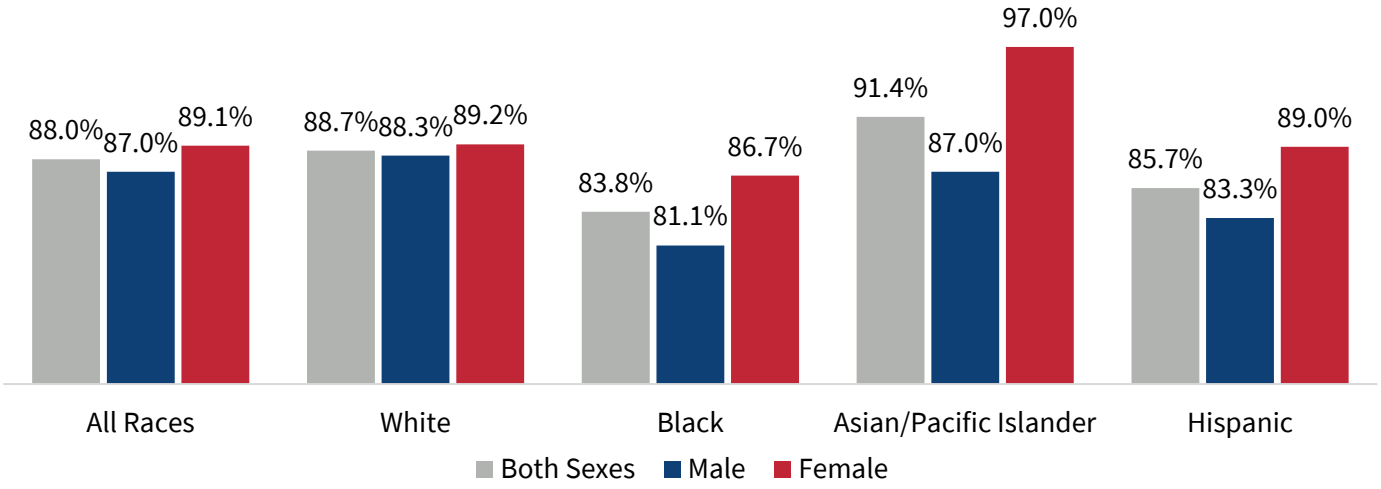
Nonmalignant brain and other CNS tumors include benign brain tumors, which are noncancerous, and borderline tumors, described as having borderline malignancy, low malignant potential, or uncertain malignant potential. Incidence data on nonmalignant primary brain and other CNS tumors are available in the Ohio Cancer Incidence Surveillance System (OCISS), Ohio's central cancer registry. Cancer registries across the nation began collecting information on nonmalignant brain and other CNS tumors beginning with 2004 diagnoses. Data collection includes all benign and borderline brain and other CNS tumors in addition to malignant cases.

In Ohio, an average of 59 cases of benign (25) and borderline (34) primary brain and CNS tumors were diagnosed among children and adolescents each year during 2017-2021.

Cancer Survival Among Children and Adolescents

Relative survival compares the survival of those diagnosed with cancer with the survival of those who do not have cancer, usually five years after a cancer diagnosis. In Ohio, five-year relative survival for children and adolescents was 88.0% (95% confidence interval: 86.8%-89.1%) for all cancers combined, based on data from 2014-2020. Five-year relative survival was slightly lower among boys, 87.0% (85.2%-88.5%) than girls, 89.1% (87.3%-90.6%), however, the difference was not statistically significant. Five-year relative survival was significantly lower among Black children and adolescents, 83.8% (79.9%-87.1%), compared with White children and adolescents, 88.7% (87.4%-89.9%). Asian/Pacific Islander children and adolescents had the highest five-year relative survival, 91.4% (82.6%-95.8%), however this was not significantly different than White, Black, or Hispanic, 85.7% (77.5%-91.1%), children and adolescents (Figure 10).

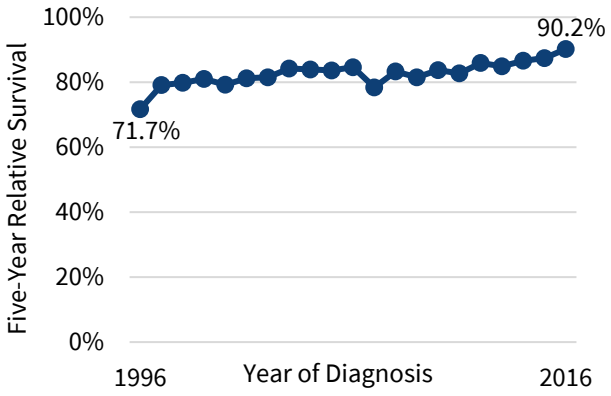
Figure 10. Five-Year Relative Survival Among Children and Adolescents (Ages 0-19) by Race, Ethnicity, and Sex, Ohio, 2014-2020



Source: Ohio Cancer Incidence Surveillance System, Ohio Department of Health, 2024.

In Ohio, the overall five-year relative survival among children and adolescents improved from 71.7% in 1996 to 90.2% in 2016 (Figure 11).

Figure 11. Trend in Five-Year Relative Survival for All Cancer Sites/Types Combined Among Children and Adolescents (Ages 0-19), Ohio, 1996-2016



Source: Ohio Cancer Incidence Surveillance System, Ohio Department of Health, 2024.

Prevalence of Cancer Among Children and Adolescents

Cancer prevalence is an estimate of the number of people alive on a certain date who have ever been diagnosed with cancer. Twenty-five-year limited-duration prevalence estimates the number of people alive on Jan. 1, 2021, who had a cancer diagnosis within the past 25 years.

An estimated 10,346 Ohioans are child and adolescent cancer survivors (i.e., Ohioans diagnosed with cancer as children or adolescents from 1996 to 2020 who were alive as of Jan. 1, 2021), per Ohio cancer registry data. Some of these individuals were cancer free, while others may have been receiving ongoing treatment.

Cancer Clinical Trials Among Children and Adolescents

Clinical trials are used to determine the most safe and effective treatment for a disease. Clinical trials aim to improve survival rates or reduce side effects or late effects of treatment. While less than 5% of adults with cancer are enrolled in clinical trials, a recent analysis by the Children's Oncology Group (COG) indicates that 19.9% of cancer cases from birth to 19 years old were enrolled onto upfront COG therapeutic trials between 2004 and 2015.[2] Although childhood cancer incidence has risen over several decades, enrollment rates appear to be declining.[2] This may be due to challenges in pediatric drug development, difficulty designing feasible trials for highly curable diagnoses, and issues ensuring trial availability for the heterogeneous group of solid and CNS tumors.[2]

[2.] Faulk KE, Anderson-Mellies A, Cockburn M, Green AL (2020) Assessment of enrollment characteristics for Children's Oncology Group (COG) upfront therapeutic clinical trials 2004-2015. PLoS ONE 15(4): e0230824. https://doi.org/10.1371/journal.pone.0230824.

Where to find child and adolescent cancer clinical trials:

National Cancer Institute, Cancer Trials Search: https://www.cancer.gov/research/participate/clinical-trials-search

Clinical Trials.gov: https://www.clinicaltrials.gov/

The Children's Oncology Group (COG): https://www.childrensoncologygroup.org/what-is-a-clinical-trial

Risk Factors for Cancer Among Children and Adolescents

There are few known risk factors for cancer among children and adolescents. A risk factor is anything that affects the chance of getting a disease such as cancer. Different cancers have different risk factors. Specific chromosomes, certain genetic syndromes, and ionizing radiation explain a small percentage of cancers among children and adolescents. Risk factors with sufficient evidence to support an increased risk of developing child and adolescent cancer are listed below.

Random mutations: Most cancers in children, like those in adults, are thought to develop because of mutations in genes that lead to uncontrolled cell growth and eventually cancer. Many DNA changes that cause most childhood cancers are likely due to random events that sometimes happen inside a cell, without having an outside cause.

Inherited mutations: Up to 10% of all cancers in children are caused by a heritable (germline) mutation (a mutation that can be passed from parents to their children). Children who have Down syndrome, a genetic condition caused by the presence of an extra copy of chromosome 21, are 10 to 20 times more likely to develop leukemia than children without Down syndrome. However, only a very small proportion of childhood leukemia is linked to Down syndrome. About 45% of children with retinoblastoma, a cancer of the eye that develops mainly in children, inherited a mutation in a gene called RB1 from a parent. Inherited mutations associated with certain familial syndromes, such as Li-Fraumeni syndrome, Beckwith-Wiedemann syndrome, Fanconi anemia syndrome, Noonan syndrome, and von Hippel-Lindau syndrome, also increase the risk of childhood cancer.

Radiation: Ionizing radiation can lead to the development of leukemia and other cancers in children and adolescents. Children whose mothers had X-rays during pregnancy and children who were exposed after birth to diagnostic medical radiation from computed tomography (CT) scans have been found to have an increased risk of leukemia and brain tumors, and possibly other cancers.

Infections: Exposure to the Epstein Barr virus (EBV) or having a personal history of mononucleosis increases the risk of lymphomas, including Hodgkin lymphoma and non-Hodgkin lymphoma.

Certain Chemicals: Benzene, found in the chemical industry, cigarette smoke, and gasoline, increases the risk of myeloid leukemia. Certain herbicides and insecticides (weed- and insect-killing substances) are linked with an increased risk of non-Hodgkin lymphoma.

Chemotherapy: Cancer patients treated with certain types of cancer treatment drugs such as alkylating agents and topoisomerase II inhibitors, sometimes later get leukemia, including AML or ALL.

Signs and Symptoms of Cancer Among Children and Adolescents

Signs and symptoms of child and adolescent cancer often look similar to other more common diseases in children, making early diagnosis difficult. Some common symptoms of child and adolescent cancer include:

- An unusual mass or swelling.
- Unexplained paleness or loss of energy.
- Sudden tendency to bruise.
- A persistent localized pain or limping.
- A prolonged unexplained fever or illness.
- Frequent headaches, often with vomiting.
- Sudden eye or vision changes.
- Excessive, rapid weight loss.

Late Effects of Cancer Among Children and Adolescents

Late effects are health problems that occur months or years after cancer is diagnosed or after treatment has ended. Late effects are related to many factors, including tumor-related factors (including the type of cancer and where it is in the body), treatment received (including dose and location), and characteristics of the survivor (including sex, age at diagnosis, genetics, family history, and health-related behaviors). Late effects include:

Second cancers: Cancer treatment can sometimes cause a new cancer years after treatment is complete. Radiation therapy and some types of chemotherapy have the strongest links to secondary cancers.

Emotional/Psychological difficulties: These may include anxiety, depression, and fear of recurrence.

Brain changes and learning and memory problems: Some chemotherapy drugs and radiation therapy to the brain can cause memory loss, problems concentrating and processing information, personality changes, and movement problems. Children who received radiation therapy to the brain or high doses of certain drugs may be more likely to have these problems.

Bone loss and joint changes: Some chemotherapy drugs, steroid medicines, hormonal therapy, and radiation therapy may cause thinning or loss of the bones. These problems can lead to loss of motion in some joints.

Heart problems: Certain chemotherapy drugs and radiation therapy to the chest may cause heart problems, including abnormal heart rhythms, leaky heart valves, congestive heart failure, and coronary artery disease.

Lung and breathing problems: Chemotherapy and radiation therapy to the chest may damage the lungs. Children who received cancer treatment at a younger age have a greater risk of lung and breathing problems.

Dental problems: Radiation therapy to the mouth, head, or neck may cause dry mouth, gum disease, and cavities. Chemotherapy, especially when given to a child whose adult teeth have not formed, may affect tooth development.

Digestive system problems: Abdominal or pelvic surgery and radiation therapy to the neck, chest, abdomen, or pelvis can result in gastrointestinal problems.

Hearing loss: Treatment with certain chemotherapy drugs and high doses of radiation to the brain can cause hearing loss. Younger children have a higher risk.

Vision and eye problems: Chemotherapy, hormone therapy, immunotherapy, and steroid medicines may increase the risk of cataracts, a clouding of the lens in the eye that affects vision. Some chemotherapy drugs and bone marrow/stem cell transplants increase the risk for dry eyes. Radioiodine treatment for thyroid cancer may cause the overproduction of tears.

Lymphedema: Lymphedema, a problem in which the lymph fluid does not drain properly, builds up in tissues, and causes swelling, can result from surgery to remove lymph nodes or by radiation therapy to areas with large numbers of lymph nodes.

Endocrine/Hormone problems: In boys, some chemotherapy drugs and radiation therapy to the lower abdomen, pelvis, or testicles may cause infertility. In girls, chemotherapy and radiation therapy to the abdomen, pelvis, or lower spine can cause infertility, irregular periods, and early menopause. In boys and girls, treatments also change levels of hormones, which can affect puberty and sexual functioning. In addition, radiation therapy to the brain can affect the pituitary glands and the endocrine system, potentially affecting fertility, growth, and puberty. Many cancer treatments may cause women to have menopausal symptoms, including hot flashes and changes in mood or sexual desire. Among men, hormone therapy for prostate cancer or surgery to remove testicles may also result in hormone-related changes to sexual desire, hot flashes, and osteoporosis.

Peripheral neuropathy: Some chemotherapy drugs can cause nerve damage, resulting in weakness, numbness, tingling, or pain, especially in the hands or feet.

Glossary and Technical Notes

Age-Adjusted Rate: A summary rate that is a weighted average of age-specific rates, where the weights represent the age distribution of a standard population (direct adjustment). The incidence and mortality rates presented in this report were standardized to the age distribution of the 2000 U.S. Standard Population. Under the direct method, the population was first divided into five age groups, i.e., <1, 1-4, 5-9, 10-14, 15-19, and the age-specific rate was calculated for each age group. Each age-specific rate was then multiplied by the standard population proportion for the respective age group. For children, the first four standardized age-specific rates were summed to give an overall age-adjusted rate. For adolescents, the standardized age-specific rate for the 15-19 age group served as the overall rate. Age adjustment allows for the comparison of rates between populations with different age distributions.

Average Annual Number: The number of cases or deaths diagnosed per year, on average, for the time period of interest (e.g., 2017-2021). Average annual numbers are calculated by summing the number of cases or deaths for a given time period, dividing by the number of years that comprise the time period, and rounding to the nearest whole number.

International Classification of Childhood Cancer (ICCC): Cancers in children and adolescents are classified by site and histology (tissue type) into 12 major groups using the International Classification of Childhood Cancers (ICCC), available at: https://seer.cancer.gov/iccc/iccc-who2008.html.

Incidence: The number of cases diagnosed during a specified time period (e.g., 2017-2021).

Invasive Cancer: A malignant tumor that has infiltrated the organ in which the tumor originated. Invasive cancers consist of those diagnosed at the localized, regional, distant, and unstaged/unknown stages. Only invasive cancers were included in the calculation of incidence rates in this document.

Late Effects: Long-term side effects from cancer treatment.

Mortality: The number of deaths during a specified time period (e.g., 2017-2021).

Population Data for Calculating Rates: Age-adjusted rates were calculated using population estimates produced by Woods & Poole Economics, Inc. (W&P) with support from the National Cancer Institute's Surveillance, Epidemiology, and End Results (SEER) Program: https://seer.cancer.gov/popdata/.

Prevalence: Cancer prevalence is an estimate of the number of people alive on a certain date who have ever been diagnosed with cancer.

Rate: The number of cases or deaths per unit of population (e.g., per 1,000,000 population), during a specified time period (e.g., 2017-2021). Child and adolescent cancer rates in this document are presented as the number of cases per 1,000,000 children and adolescents per year. Rates may be unstable and are not presented when the case count is less than five or the death count is less than 10.

Relative Survival: The percentage of people alive at a designated time point after a cancer diagnosis (usually five years) divided by the percentage expected to be alive in the absence of cancer based on normal life expectancy. The survival duration in months was calculated with all patients presumed alive if not known to be deceased. Relative survival statistics were calculated using life tables based on county-level socioeconomic status, geography, and race. Relative survival data in this report were calculated using SEER*Stat software version 8.4.3. For more information on survival analysis using SEER*Stat, see: https://seer.cancer.gov/seerstat/tutorials/survival1.

Statistically Significant: In statistics, this phrase describes a mathematical measure of difference between groups. The difference is said to be statistically significant if it is greater than what might be expected to happen by chance alone.

Appendix

Table 3. Average Annual Number of Invasive Cancer Cases and Age-Adjusted Incidence Rates Among Children and Adolescents (Ages 0-19) by County of Residence, Ohio, 2017-2021

	Cases	Rate		Cases	Rate		Cases	Rate
Ohio	552	187.6	Greene	9	212.7	Morrow	2	224.0
SEER		187.9	Guernsey	1	129.8	Muskingum	4	185.3
Adams	2	246.0	Hamilton	38	176.9	Noble	<1	*
Allen	5	169.3	Hancock	2	127.9	Ottawa	1	154.4
Ashland	4	281.6	Hardin	2	209.6	Paulding	<1	*
Ashtabula	3	142.5	Harrison	<1	*	Perry	1	128.2
Athens	2	132.8	Henry	2	286.4	Pickaway	4	265.8
Auglaize	2	147.3	Highland	3	231.5	Pike	3	386.2
Belmont	4	269.0	Hocking	1	146.7	Portage	8	218.1
Brown	2	201.2	Holmes	3	212.8	Preble	2	214.7
Butler	16	156.1	Huron	3	178.8	Putnam	1	147.1
Carroll	1	218.7	Jackson	3	305.6	Richland	5	165.0
Champaign	1	119.5	Jefferson	3	215.5	Ross	4	197.2
Clark	7	204.8	Knox	3	162.0	Sandusky	3	227.3
Clermont	10	199.8	Lake	10	187.6	Scioto	5	293.1
Clinton	2	192.8	Lawrence	3	201.1	Seneca	2	143.9
Columbiana	5	226.2	Licking	9	206.1	Shelby	3	197.7
Coshocton	2	250.1	Logan	2	172.8	Stark	16	181.8
Crawford	2	176.6	Lorain	15	192.0	Summit	27	214.1
Cuyahoga	49	164.6	Lucas	18	163.1	Trumbull	10	220.0
Darke	2	149.2	Madison	2	182.4	Tuscarawas	5	213.1
Defiance	1	96.7	Mahoning	11	206.0	Union	4	218.3
Delaware	12	204.1	Marion	3	210.5	Van Wert	1	165.2
Erie	2	116.3	Medina	8	186.0	Vinton	<1	*
Fairfield	10	236.1	Meigs	<1	*	Warren	14	218.2
Fayette	1	134.0	Mercer	2	182.6	Washington	3	222.8
Franklin	65	187.6	Miami	6	234.5	Wayne	7	228.0
Fulton	2	148.1	Monroe	<1	*	Williams	2	257.1
Gallia	<1	*	Montgomery	21	154.7	Wood	6	170.4
Geauga	7	278.3	Morgan	<1	*	Wyandot	1	228.1

Source: Ohio Cancer Incidence Surveillance System, Ohio Department of Health, 2024; Surveillance, Epidemiology and End Results Program, National Cancer Institute, 2024 (based on cancer cases diagnosed in SEER 22 area registries from 2017-2021 using SEER*Stat version 8.4.3).
Rates are per 1,000,000 and age-adjusted to the 2000 U.S. standard population.
*Rate not presented when the count for 2017-2021 is less than five (i.e., the average annual count is less than one).

Sources of Additional Information

American Cancer Society:

- Cancer in Children: https://www.cancer.org/cancer/cancer-in-children.html
- Cancer in Adolescents: https://www.cancer.org/cancer/cancer-in-adolescents.html

National Cancer Institute:

- Childhood Cancers: https://www.cancer.gov/types/childhood-cancers
- Adolescents and Young Adults with Cancer: https://www.cancer.gov/types/aya
- Fact sheet: Cancer in Children and Adolescents

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