

CANCER INCIDENCE AMONG CHILDHOOD RESIDENTS OF
CLYDE CITY AND GREEN CREEK TOWNSHIP,
SANDUSKY COUNTY, OHIO
1996-2006

Chronic Disease and Behavioral Epidemiology Section and the
Ohio Cancer Incidence Surveillance System
Ohio Department of Health

and

Sandusky County Department of Public Health

Final Report
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INTRODUCTION

A. Background

Residents of Clyde City, Green Creek Township and surrounding areas in Sandusky County, Ohio have expressed concerns to the Sandusky County Department of Public Health (SCDPH) of a perceived high rate of cancer among children in the community. As of June 2006, 11 children in Clyde and surrounding areas ages six months to 18 years were reported by residents as having been diagnosed with cancer in recent years. In response to these concerns, on June 16, 2006 the SCDPH requested assistance from the Ohio Department of Health (ODH) in determining the incidence of childhood cancer among residents of Clyde City and Green Creek Township.¹ The SCDPH also inquired if this incidence of cancer differed in a significant way from that expected based on a suitable comparison population.

B. Objectives

There are three primary objectives for this cancer assessment:

[1] Determine the incidence of cancer among childhood residents (ages 0-19) of Clyde City and Green Creek Township, by anatomical site/type of cancer, for the years 1996-2006 and 2002-2006;

[2] Determine the incidence of cancer among childhood residents (ages 0-19) of Sandusky County, Fremont City and the townships of Green Creek (remainder, i.e., excluding Clyde), Riley, Townsend and York combined, by anatomical site/type of cancer, for the years 1996-2006 and 2002-2006; and

[3] Determine if the incidence of cancer among childhood residents of the study populations differs in a statistically significant way from that expected based on national background cancer incidence rates.

METHODS

A. Study Populations

The primary study population was defined as childhood residents (ages 0-19) of Clyde City and Green Creek Township, Sandusky County, Ohio (Figure 1). The 2000 Census of Population counts for the 0-19 age group in Clyde City and the remainder of Green Creek Township were 1,813 and 985, respectively.² In addition, the following childhood populations were selected for comparison: Sandusky County (Figure 2; N=17,742); Fremont City (Figure 3; N=5,258); and the townships of Green Creek (remainder), Riley, Townsend and York combined (Figure 4; N=2,544). The year 2000 population was over 96 percent white race in Clyde City and over 92 percent white race in Sandusky County.²

A "case" was defined as a child age 0-19 diagnosed with invasive cancer while a resident of one of the study populations. Cancer cases were identified through the Ohio Cancer Incidence

Surveillance System (OCISS), the central cancer registry for the state of Ohio.^{3,4} All cancers diagnosed among Ohio residents on or after January 1, 1992, with the exception of basal and squamous cell carcinoma of the skin and cervical cancer *in situ*, are required to be reported to the OCISS. Invasive cancers diagnosed from 1996-2006 were used in the analysis. The OCISS currently publishes cancer incidence counts and rates for the years 1996-2003 as these years represent the most accurate and complete data available.³ To address resident concerns of cancers diagnosed in recent years, efforts were made to ascertain all childhood cancers among Sandusky County residents for the years 2004-2006. Methods to obtain these cases included:

[1] Review of OCISS cancer reports for the years 2004-2006;⁴

[2] Verification of cancers reported by community residents to the SCDPH; and

[3] Contacting all hospitals with a history of reporting cancers among childhood residents of Sandusky County to identify any cancers not yet reported to the OCISS.

Cancer cases identified through these methods were mapped in ArcMap using geocoded (address locator) information to accurately classify cases into the primary and comparison study populations.⁵

B. National Comparison Data

The incidence of cancer among the study populations was compared to national cancer incidence rates from the Surveillance Epidemiology and End Results (SEER) Program of the National Cancer Institute.⁶ SEER collects and publishes cancer incidence data from 17 population-based registries covering 26 percent of the U.S. population. A SEER region consisting of 13 registries (SEER 13) was used in the analyses as the years of data available for this region are most comparable to the study period. Rates for the white population were used to most closely correspond to the racial composition of the study populations.

C. Analyses

Cases in the study populations were categorized by International Classification of Diseases for Oncology, Third Edition (ICD-O-3) codes into the 23 cancer site/type groupings used by the SEER Program.⁷ These cases will hereafter be referred to as "observed" cases.

The number of cases expected to have been diagnosed in the study populations in 1996-2006, hereafter referred to as "expected" cases, was calculated using 1996-2003 age-specific incidence rates from the SEER 13 region generated using SEER*Stat software.⁶ The time period 1996-2003 was selected to generate the expected numbers as these years of available data most closely correspond to the time period of analysis (Note: national data post 2003 were not available at the time of this study). For the 2002-2006 study period, SEER data for the years 2000-2003 were used to generate the expected numbers of cases. The age-specific SEER rates were multiplied by the age-specific population counts of the study populations to generate expected numbers for each population.

The observed and expected numbers were compared for all cancer sites/types combined and for each specific site/type of cancer diagnosed among the study populations. The Standardized

Incidence Ratio (SIR) was used to compare the observed and expected numbers of cases, where:

$$\text{SIR} = \text{Observed cases} / \text{Expected cases}$$

A SIR greater than one indicates more observed cases than expected, and a SIR less than one indicates fewer observed cases than expected. Significance of the SIR was determined by calculating 95% confidence intervals (CI) based on the Poisson distribution using Fisher's Exact Test.⁸ If the confidence interval for a given SIR did not include one, the difference between the observed and expected numbers was determined to be statistically significant ($p < 0.05$).

RESULTS

A total of 10 invasive cases of cancer were diagnosed from 1996-2006 among childhood residents of Clyde City and Green Creek Township; seven cases resided within Clyde City limits and three cases in the remainder of Green Creek Township. This equates to about one case per year among a childhood population of 2,798 residents ages 0-19. As shown in Table 1, equal numbers of cases were diagnosed in males (5 cases, 50%) and females (5 cases, 50%), with the largest number being diagnosed in the 15-19 years age group (4 cases, 40%). A breakdown of cases by year of diagnosis indicates an increase in the number of cases during the time period; no cases were diagnosed from 1996-2000, whereas, six of the 10 cases (60%) were diagnosed in 2005-2006.

The most commonly diagnosed cancer site/type in Clyde City and Green Creek Township was brain and other central nervous system (CNS) cancer (4 cases). No other cancer sites/types were found to be in common among the cases, with only one case of each of the following cancers being diagnosed: Ewing's sarcoma (soft tissue); Hodgkin's lymphoma; leukemia (specifically, acute lymphocytic leukemia, i.e., ALL); osteosarcoma (bone); rhabdomyosarcoma; and testis (Table 2). Please note: of these 10 cases, three were diagnosed in Green Creek Township—two brain and other CNS cancers and one osteosarcoma.

The observed (O) number of cases in 1996-2006 was compared to the number expected (E) for all sites/types combined in Clyde City and Green Creek Township, as well as the comparison populations of Sandusky County, Fremont City and the townships of Green Creek (remainder), Riley, Townsend and York combined (Table 3). For the primary study population of Clyde City and Green Creek Township, the number of cases observed ($O=10$) was about twice the number expected ($E=5.32$), although this difference was not found to be statistically significant at the 95 percent confidence level ($\text{SIR}=1.88$; $95\% \text{ CI}=0.90-3.46$). A breakdown of the combined study area reveals that neither Clyde City ($O=7$) nor Green Creek Township ($O=3$) by itself has a statistically significant higher than expected cancer burden for this time period. The observed numbers of cases in Sandusky County ($O=36$) and Fremont City ($O=10$) were also not significantly different from the expected numbers for either region at the 95 percent confidence level. Eleven cancers were observed in the four-township study population surrounding and to the northeast of Clyde City (3 cancers in Green Creek Township, as noted previously, plus an additional 8 cancers in Riley, Townsend and York Townships). In contrast to the other study populations, this four-township region was determined to have a statistically significant higher number of cancers than expected based on national comparison rates ($O=11$; $E=4.86$; $\text{SIR}=2.26$; $95\% \text{ CI}=1.13-4.05$).

A breakdown of the four-township study population of Green Creek, Riley, Townsend and York by cancer site/type did not reveal any commonalities with the exception of three cases of brain and other CNS cancer (two cases in Green Creek Township, as noted previously, and one case in York Township). The remaining eight cancers consisted of one case of each of the following: Hodgkin's lymphoma; leukemia (specifically, acute myelocytic leukemia); liver and intrahepatic bile duct; melanoma of the skin; non-Hodgkin's lymphoma; osteosarcoma (in Green Creek Township, as noted previously); polycythemia vera; and rhabdomyosarcoma.

To address resident concerns of cancers diagnosed in recent years, observed and expected numbers were calculated and compared in each of the study populations for the most recent five-year time period of 2002-2006 (Table 4). In contrast to the analyses for the 11-year period 1996-2006, statistically significant higher than expected numbers of cancers were diagnosed from 2002-2006 in the primary study population of Clyde City and Green Creek Township as well as the four-township population of Green Creek (remainder), Riley, Townsend and York. In 2002-2006, Clyde City and Green Creek Township had eight observed cases (6 in Clyde City and 2 in Green Creek Township) with 2.47 expected, resulting in a statistically significant SIR (3.24) at the 95 percent confidence level (1.40-6.38). A statistically significant higher than expected number of cancers were located within Clyde City limits (O=6; E=1.60; SIR=3.75; 95% CI=1.38-8.16), which contributed to the overall excess burden in the combined region. The SIR for the four-township population was found to be even greater in 2002-2006 compared to 1996-2006 and was statistically significant (O=7; E=2.25; SIR=3.11; 95% CI=1.25-6.41). The numbers of cancers diagnosed in Sandusky County (O=17) and Fremont City (O=1) in 2002-2006 did not differ significantly from the expected at the 95 percent confidence level.

The most common cancer site/type among children in the Clyde City and Green Creek Township study population was brain and other CNS cancer (4 cases). In 1996-2006, less than one case of this cancer site/type would be expected, resulting in a significant number of observed cases in the region (SIR=4.35; 95% CI=1.18-11.13). In comparison, Sandusky County as a whole had a higher number, but not a statistically significant higher number, of observed brain and other CNS cancers (O=8; E=5.85; SIR=1.37; 95% CI=0.59-2.69) (Table 5).

DISCUSSION

The assessment of a community's cancer burden is a complex task due to the small size of the study population and the instability in case counts over time. The OCISS, which was established in 1992, is a relatively new registry that currently has only eight years of complete, accurate and reliable data (1996-2003). To address resident concerns of cancers diagnosed in recent years, efforts were made to contact every facility with a history of reporting Sandusky County childhood cancers, although it is possible not all cases were obtained. Media attention in Clyde and surrounding areas may have resulted in more complete reporting in this region compared to other areas of Sandusky County. Thus, the statistically significant burden of cancer in Clyde City and areas to the northeast may not differ as much from other areas of the county as the data would indicate. The inclusion of 11 years of data increases the ability to identify patterns of disease over time, although this time period is still relatively short which may lead to erroneous conclusions.

Community cancer assessments are also difficult due to inaccurate classification of the city of residence. The use of ArcMap to plot the exact latitude and longitude of each address helps to reduce this potential bias, although the science is not exact due to boundary and road changes over time. In addition, residence is classified by the address at diagnosis, which may not be the child's primary residence throughout their lifetime. History of residence is not collected by the OCISS and thus cannot be accounted for in this assessment.

The SEER Program of the National Cancer Institute was used to generate the expected numbers of cancer cases because it is a high-quality population-based cancer reporting system that is comparable to the U.S. population. However, the demographics of the SEER population differ somewhat from the demographics of Clyde City and Green Creek Township as well as the comparison populations. To reduce the problem of differing demographic compositions, the SEER white population was selected for analysis to most closely represent the racial demographics of the study areas.

The assessment of a community's cancer burden is also complex because cancer is not just one disease, but as many as 200 diseases that differ with respect to risk factors, latency, course of disease and probability of survival. The total number of cancer cases diagnosed among Clyde City and Green Creek Township residents was determined to be significantly higher than expected, but it is difficult to determine the causes of each case of cancer due to the multitude of risk factors, and the interaction of these factors, that play a role in cancer development.

It is the goal of a community cancer assessment to identify the cancers most prevalent in a particular area and the demographics of those cancer cases so that appropriate prevention, early detection and control programs can be developed and implemented in the community. A summary of risk factors for the sites/types of cancer found in Clyde City and Green Creek Township is presented below to assist in the development of such programs:

Brain and Other CNS Cancer: Cancers of the brain and other CNS account for 17 percent of all pediatric cancers, second only to leukemias.⁹ The causes of brain cancer are largely unknown, and most brain tumors are not associated with known risk factors.^{9,10} The only established environmental risk factor is exposure to ionizing radiation, such as radiation used in the treatment of tinea capitis or leukemia in children. Gene mutations that cause some inherited syndromes, such as neurofibromatosis and Li-Fraumeni syndrome, are associated with increased risk.¹⁰ Family history of a type of brain cancer called glioma increases risk of glioma; however, only rare cases run in families.¹¹ The majority of brain tumors in children are diagnosed before age five, suggesting that a developmental defect may be responsible for cancer development.⁹

Ewing's Sarcoma: Ewing's sarcomas are a family of tumors found primarily in bone (60%) and soft tissue (40%) and are most commonly diagnosed in adolescents. These tumors are relatively rare and account for only 2-3 percent of all childhood cancers. Environmental exposures to radiation, chemicals or other factors have not been shown to increase risk of Ewing's sarcoma. In fact, little is known about the causes of Ewing's sarcomas, although a genetic translocation of chromosome 22 after birth has been associated with the disease.¹²

Hodgkin's Lymphoma: About 10-15 percent of Hodgkin's lymphomas, also known as Hodgkin's Disease, occur in children ages 16 years and younger.¹³ The causes of Hodgkin's

lymphoma are unknown, although a number of factors have been associated with increased risk of the disease: infection with the Epstein-Barr (EB) virus; reduced immunity, such as from Acquired Immunodeficiency Syndrome (AIDS), immunosuppressant drugs following organ transplants and congenital immunodeficiency syndromes; and a history of Hodgkin's lymphoma among siblings.^{13,14} No associations have been found between smoking or other lifestyle factors and Hodgkin's lymphoma.

Leukemias: A number of environmental and genetic risk factors have been associated with leukemias. Radiation exposure (such as from an atomic bomb explosion, nuclear reactor accident or radiation to the fetus during the first months of development) is the only known environmental risk factor for ALL.^{15,16} Rare cases of ALL have also been associated with EB virus infection, human t-cell leukemia/lymphoma (HTLV-1) infection and Burkitt's lymphoma.¹⁵ Leukemias do not appear to be inherited, although certain genetic syndromes such as Down, Klinefelter and Li-Fraumeni have been associated with increased risk.^{15,16}

Osteosarcoma: Osteosarcoma is the most common type of primary bone cancer in children and young adults. This cancer type is most prevalent among teenagers, although only about 900 cases are diagnosed in the United States each year. Risk factors for osteosarcoma include: radiation treatment for another cancer; rapid bone growth; bone diseases such as Paget's disease and osteochondromas; Li Fraumeni syndrome; and retinoblastoma (a rare eye cancer in children). Most osteosarcomas are not caused by inherited DNA mutations, rather from mutations acquired during the person's lifetime.¹⁷

Rhabdomyosarcoma: Rhabdomyosarcoma is the most common cancer of the soft tissues.¹⁸ Environmental exposure to toxic substances, air pollution, drugs or radiation to the fetus have not been associated with increased risk of rhabdomyosarcoma.¹⁹ In fact, congenital anomalies and genetic conditions are the only known risk factors for rhabdomyosarcoma and include: Li Fraumeni syndrome, Beckwith-Wiedmann syndrome; neurofibromatosis; and Costello syndrome.^{18,19}

Testis: Testicular cancer is most commonly diagnosed among males ages 20-54. The primary risk factor for this cancer type is cryptorchidism, a condition in which one or both testicles do not descend into the scrotum before birth. Other risk factors include: family history of testicular cancer; multiple atypical nevi (moles); and infection with the Human Immunodeficiency Virus (HIV). Environmental exposures are not typically associated with testicular cancer.²⁰

CONCLUSIONS

This assessment of cancer in Clyde City and Green Creek Township, Ohio revealed higher than expected numbers of childhood cancers for both the 11-year time period 1996-2006 and the recent five-year period 2002-2006, although statistical significance was achieved for only the 2002-2006 study period. Case counts increased from 1996-2006, with no cases diagnosed prior to 2001 and the majority diagnosed in 2005-2006. Thus, these data indicate a recent temporal (time) phenomenon in the pattern of childhood cancers in the region. A demographic breakdown of the 10 cases diagnosed from 1996-2006 did not indicate any differences by gender but found the cancer burden to be most prevalent in the 15-19 years age group.

A statistically significant cancer burden was found not only in the Clyde City and Green Creek Township study population during 2002-2006, but also in the four-township area surrounding and to the northeast of Clyde during both study periods. In contrast, the number of cancers diagnosed in the neighboring city of Fremont and in all of Sandusky County was similar to what would be expected in both 1996-2006 and 2002-2006.

Brain and other CNS cancer was found to be most common among the Clyde City and Green Creek Township population with four cases and was significantly higher at the 95 percent confidence level than would be expected based on national data. The remaining six cancer cases were each of a different site/type and vary with respect to risk factors, latency, course of disease and probability of survival. A review of risk factors for these seven cancer sites/types revealed some commonalities, although the causes of most childhood cancers are largely unknown. With respect to environmental risk factors for these cancers, radiation has been associated with the following sites/types: brain and other CNS cancer; leukemia; and osteosarcoma. Li-Fraumeni syndrome, a rare, inherited syndrome caused by a gene mutation, was common to brain and other CNS cancer; leukemia; osteosarcoma; and rhabdomyosarcoma.

The exact causes of each case of cancer cannot be determined from this assessment due to the variety of cancer sites/types diagnosed among the study population; the scarcity of known risk factors for childhood cancer; and the lack of case information on history of environmental exposures, length of residence, health behaviors and other cancer-related risk factors. It is hoped these findings can be used to educate residents of Clyde City and surrounding areas on the cancer burden in their community; provide a basis for prevention and early detection programs; and guide efforts to monitor and control childhood cancer in the future.

Figure 1: Clyde City and Green Creek Township

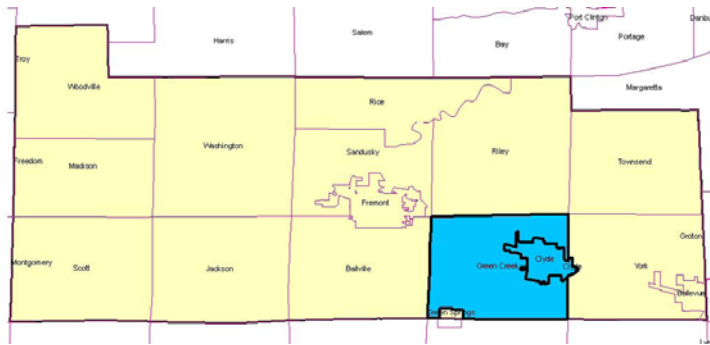


Figure 2: Sandusky County

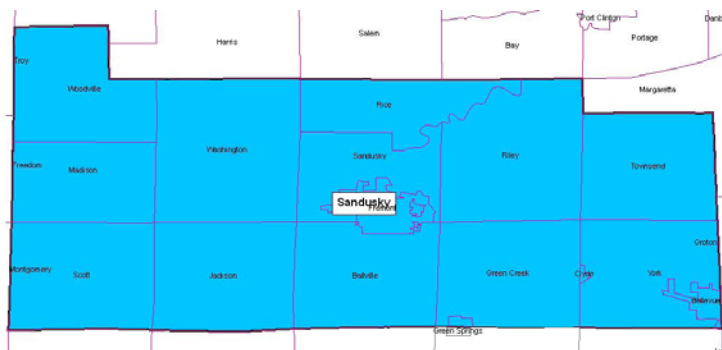


Figure 3: Fremont City



Figure 4: Green Creek (remainder), Riley, Townsend and York Townships

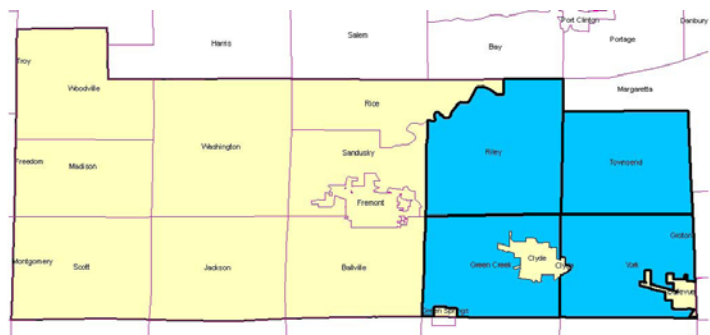


Table 1. Number and Percent of Invasive Cancer Cases by Gender, Age Group and Year of Diagnosis Among Children Ages 0-19 in Clyde City and Green Creek Township, Ohio, 1996-2006¹

	1996-2006 Cases	Percent
Gender		
Male	5	50%
Female	5	50%
Age Group		
0-4	1	10%
5-9	3	30%
10-14	2	20%
15-19	4	40%
Year of Diagnosis		
1996	0	0%
1997	0	0%
1998	0	0%
1999	0	0%
2000	0	0%
2001	2	20%
2002	1	10%
2003	1	10%
2004	0	0%
2005	2	20%
2006	4	40%
Total	10	100%

[1] Source: Ohio Cancer Incidence Surveillance System and the Chronic Disease and Behavioral Epidemiology Section, Ohio Department of Health, February 2007.

Table 2. Number and Percent of Invasive Cancer Cases, by Site/Type, Among Children Ages 0-19 in Clyde City and Green Creek Township, Ohio, 1996-2006¹

Cancer Site/Type	1996-2006 Cases	Percent
Brain and Other CNS*	4	40%
Ewing's Sarcoma (Soft Tissue)	1	10%
Hodgkin's Lymphoma	1	10%
Leukemias	1	10%
Osteosarcoma (Bone)	1	10%
Rhabdomyosarcoma	1	10%
Testis	1	10%
All Cancer Sites/Types	10	100%

[1] Source: Ohio Cancer Incidence Surveillance System and the Chronic Disease and Behavioral Epidemiology Section, Ohio Department of Health, February 2007.

*CNS = Central Nervous System

Table 3. Observed and Expected Numbers of Invasive Cancer Cases, Standardized Incidence Ratios (SIR) and 95% Confidence Intervals (CI), for All Cancer Sites/Types Combined among Children Ages 0-19 in Clyde City and Green Creek Township, Sandusky County, Fremont City and the Townships of Green Creek (remainder), Riley, Townsend and York Combined, Ohio, 1996-2006^{1,2,3}

Region	Census 2000 Population	1996-2006 Observed Cases	1996-2006 Expected Cases	SIR	95% CI
Clyde City and Green Creek Twp.	2,798	10	5.32	1.88	0.90-3.46
Clyde City	1,813	7	3.44	2.03	0.82-4.19
Remainder of Green Creek Twp.	985	3	1.87	1.60	0.33-4.69
Sandusky County	17,742	36	33.80	1.07	0.75-1.47
Fremont City	5,258	10	10.17	0.98	0.47-1.81
Green Creek (remainder), Riley, Townsend & York Twps.*	2,544	11	4.86	2.26	1.13-4.05

[1] Source: Ohio Cancer Incidence Surveillance System and the Chronic Disease and Behavioral Epidemiology Section, Ohio Department of Health, February 2007.

[2] Surveillance, Epidemiology, and End Results (SEER) Program, U.S. age-specific incidence rates for 1996-2003, white population, SEER 13 Reg Public Use, Nov 2005 Sub (1992-2003).

[3] 95% confidence intervals were calculated based on a Poisson distribution using Fisher's Exact test.

* A significantly higher than expected number of cancer cases were diagnosed during this time period.

Table 4. Observed and Expected Numbers of Invasive Cancer Cases, Standardized Incidence Ratios (SIR) and 95% Confidence Intervals (CI), for All Cancer Sites/Types Combined among Children Ages 0-19 in Clyde City and Green Creek Township, Sandusky County, Fremont City and the Townships of Green Creek (remainder), Riley, Townsend and York Combined, Ohio, 2002-2006^{1,2,3}

Region	Census 2000 Population	2002-2006 Observed Cases	2002-2006 Expected Cases	SIR	95% CI
Clyde City and Green Creek Twp.*	2,798	8	2.47	3.24	1.40-6.38
Clyde City*	1,813	6	1.60	3.75	1.38-8.16
Remainder of Green Creek Twp.	985	2	0.87	2.30	0.28-8.30
Sandusky County	17,742	17	15.68	1.08	0.63-1.74
Fremont City	5,258	1	4.72	0.21	0.01-1.18
Green Creek (remainder), Riley, Townsend & York Twps.*	2,544	7	2.25	3.11	1.25-6.41

[1] Source: Ohio Cancer Incidence Surveillance System and the Chronic Disease and Behavioral Epidemiology Section, Ohio Department of Health, February 2007.

[2] Surveillance, Epidemiology, and End Results (SEER) Program, U.S. age-specific incidence rates for 2000-2003, white population, SEER 13 Reg Public Use, Nov 2005 Sub (1992-2003).

[3] 95% confidence intervals were calculated based on a Poisson distribution using Fisher's Exact test.

* A significantly higher than expected number of cancer cases were diagnosed during this time period.

Table 5. Observed and Expected Numbers of Invasive Brain & Other CNS Cancer Cases, Standardized Incidence Ratios (SIR) and 95% Confidence Intervals (CI), among Children Ages 0-19 in Clyde City and Green Creek Township Compared to Sandusky County, Ohio, 1996-2006^{1,2,3}

Region	Census 2000 Population	1996-2006 Observed Cases	1996-2006 Expected Cases	SIR	95% CI
Clyde City and Green Creek Twp.*	2,798	4	0.92	4.35	1.18-11.13
Sandusky County	17,742	8	5.85	1.37	0.59-2.69

[1] Source: Ohio Cancer Incidence Surveillance System and the Chronic Disease and Behavioral Epidemiology Section, Ohio Department of Health, February 2007.

[2] Surveillance, Epidemiology, and End Results (SEER) Program, U.S. age-specific incidence rates for 1996-2003, white population, SEER 13 Reg Public Use, Nov 2005 Sub (1992-2003).

[3] 95% confidence intervals were calculated based on a Poisson distribution using Fisher's Exact test.

* A significantly higher than expected number of cancer cases were diagnosed during this time period.

REFERENCES

¹Letter dated June 16, 2006 from David G. Pollick, MA and Ed, Health Commissioner, Sandusky County Department of Public Health to Robert Indian, MS, Chief, Chronic Disease and Behavioral Epidemiology Section, Bureau of Health Surveillance, Division of Prevention, Ohio Department of Health.

²U.S. 2000 Census of Population: Ohio. Census 2000 Summary File 1 (SF1) 100-Percent Data, U.S. Department of Commerce, Bureau of the Census, Washington, D.C., 2002.

³Ohio Cancer Incidence Surveillance System, Ohio Department of Health, 1996-2003 data release, April 2006.

⁴Ohio Cancer Incidence Surveillance System, Ohio Department of Health, 2004-2006 cancer reports in live database, accessed December 2006.

⁵ESRI ArcMap 9.1. Leica Geosystems GIS Mapping, LLC; Microsoft Corporation; LizardTech Inc. Copyright 1999-2005 ESRI Inc.

⁶Surveillance, Epidemiology and End Results (SEER) Program (www.seer.cancer.gov) SEER*Stat Database: Incidence – SEER 13 Regs Public-Use, Nov 2005 Sub (1975-2003), National Cancer Institute, DCCPS, Surveillance Research Program, Cancer Statistics Branch, released April 2006, based on the November 2005 submission.

⁷International Classification of Diseases for Oncology, Third Edition. World Health Organization, Geneva, Switzerland, 2000.

⁸Open Epi: SMR Analysis version 4.11.19, Rollins School of Public Health, Emory University <http://www.sph.emory.edu/~cdckms/exact-midP-SMR.html>. Fishers Exact Test based on (Armitage, 1971; Snedecor & Cochran, 1965), as described in Epidemiologic Analysis with a Programmable Calculator, 1979.

⁹BenchMarks: Pediatric Brain Tumors. National Cancer Institute, April 26, 2005. <http://www.cancer.gov/newscenter/benchmarks-vol5-issue2>

¹⁰Detailed Guide: Brain/CNS Tumors in Children. American Cancer Society, 2007. http://www.cancer.org/docroot/CRI/CRI_2_3x.asp?dt=4

¹¹What You Need to Know About Brain Tumors. National Cancer Institute, posted March 31, 2003. <http://www.cancer.gov/cancertopics/wyntk/brain>

¹²Detailed Guide: Ewing's Family of Tumors. American Cancer Society, 2007. http://www.cancer.org/docroot/CRI/CRI_2_3x.asp?dt=48

¹³Detailed Guide: Hodgkin Disease. American Cancer Society, 2007. http://www.cancer.org/docroot/CRI/CRI_2_3x.asp?dt=84

¹⁴What You Need to Know About Hodgkin's Disease. National Cancer Institute, posted September 16, 2002. <http://www.cancer.gov/cancertopics/wyntk/hodgkins>

¹⁵Detailed Guide: Leukemia—Acute Lymphocytic (ALL). American Cancer Society, 2007. http://www.cancer.org/docroot/CRI/CRI_2_3x.asp?dt=57

¹⁶Detailed Guide: Leukemia—Children's. American Cancer Society, 2007. http://www.cancer.org/docroot/CRI/CRI_2_3x.asp?dt=24

¹⁷Detailed Guide: Osteosarcoma. American Cancer Society, 2007. http://www.cancer.org/docroot/CRI/CRI_2_3x.asp?dt=52

¹⁸Soft Tissue Sarcomas, in Ries LAG, Smith MA, Gurney JG, et. al. (eds). *Cancer Incidence and Survival among Children and Adolescents: United States SEER Program 1975-1995*, National Cancer Institute, SEER Program. NIH Pub. No. 99-4649. Bethesda, MD, 1999. <http://seer.cancer.gov/publications/childhood/softtissue.pdf>

¹⁹Detailed Guide: Rhabdomyosarcoma. American Cancer Society, 2007. http://www.cancer.org/docroot/CRI/CRI_2_3x.asp?dt=53

²⁰Detailed Guide: Testicular Cancer. American Cancer Society, 2007. http://www.cancer.org/docroot/CRI/CRI_2_3x.asp?dt=41