Report on the

Spatial and Temporal Variation in the Incidence of Selected Cancers

Demonstration Project on

Geographic Patterns of Cancer Incidence and Environmental Factors in New Jersey
Phase 1: Surveillance (Tracking) Activities

Program 03074, Environmental and Health Effects Tracking
National Center for Environmental Health
Centers for Disease Control and Prevention (CDC)

Submitted to the CDC
January 31, 2007

Prepared by the

New Jersey Department of Health and Senior Services
Consumer and Environmental Health Services
Environmental Public Health Tracking Project
and
Cancer Epidemiology Services

In cooperation with the
New Jersey Department of Environmental Protection

Table of Contents

Overview of the Demonstration Project

The New Jersey Department of Health and Senior Services (NJDHSS) was awarded funding from the Centers for Disease Control and Prevention (CDC) to conduct three demonstration projects under the program, "Environmental and Health Effects Tracking," in cooperation with the New Jersey Department of Environmental Protection (NJDEP). The purpose of these demonstration projects is to develop and evaluate methods for linking ongoing, existing health effects and human exposure surveillance systems with existing systems for monitoring environmental hazards and exposures.

One of the three demonstration projects by NJDHSS and NJDEP is to link cancer incidence data with data on environmental hazards and exposures. Environmental factors are known or suspected to play an important role in the etiology of several cancer types. This demonstration project will allow NJDHSS and NJDEP to proactively evaluate the geographic relationships among the incidences of selected cancer types and specific environmental hazards or exposures.

The project was conducted in two phases. Phase 1, described in this report, involves identification of specific cancer types of interest, and descriptive analysis of incidence data for these cancers, specifically for temporal trends and spatial patterns. The second phase, described in a separate report, involves the linkage of the cancer incidence and environmental databases to examine specific relationships suggested in the first phase.

This demonstration project was conducted by the Environmental Public Health Tracking Project (EPHT) in Consumer and Environmental Health Services, NJDHSS, in partnership with Cancer Epidemiology Services (CES), NJDHSS and the New Jersey Department of Environmental Protection (NJDEP).

Study Team

New Jersey Department of Health and Senior Services

Consumer and Environmental Health Services

Jerald Fagliano, M.P.H., Ph.D., Principal Investigator
Michael Berry, M.P.H.
Perry Cohn, Ph.D., M.P.H.
Barbara Goun, M.P.H., Ph.D., Project Coordinator
Patricia Haltmeier, L.P.N.
Richard Opiekun, M.S., M.A., Ph.D.

Cancer Epidemiology Services
Kevin Henry, PhD.
Betsy Kohler, M.P.H., C.T.R
Lisa Roche, M.P.H., Ph.D.

New Jersey Department of Environmental Protection

Steven Anderson, M.S.
Linda Bonanno, Ph.D.
Judith Klotz, M.S., Dr.P.H., consultant

Summary

This demonstration project was conducted by the Environmental Public Health Tracking Project (EPHT) in Consumer and Environmental Health Services, NJDHSS, in partnership with Cancer Epidemiology Services (CES), NJDHSS and the New Jersey Department of Environmental Protection (NJDEP). The project first identified specific cancer types of interest to EPHT, and then conducted descriptive analysis of incidence data for these cancers, specifically for temporal trends and spatial patterns.

Temporal Variation: Annual age-adjusted rates were calculated for 14 cancer groupings and several histological subtypes separately for males and females from 1979 through 2001. In addition, annual age-adjusted rates by sex were calculated for three cancer groupings for children (under age 20 at time of diagnosis) for the same time period.

The incidence rates of many of the cancer types examined for this demonstration project were found to have been generally steady in New Jersey over the period 1979 through 2001. Cancers with generally steady incidence rates included: leukemia; urinary bladder cancer; brain and other central nervous system cancer; mesothelioma; soft tissue sarcoma; nasopharyngeal cancer; cancer of the nose, nasal cavity and middle ear; and osteosarcoma. The incidence rates of the selected childhood cancers were generally stable over the period, for all childhood cancers combined, and for leukemia, and brain and other nervous system cancers, the two most common types of cancer in children.

The incidence rates for certain cancer types increased over the time interval. Thyroid cancer increased in both sexes, but especially in females. Rates of non-Hodgkin lymphoma, liver cancer, and kidney cancer also increased in both sexes. However, rates of angiosarcoma of the liver, which is associated with occupational exposure to vinyl chloride, did not appear to be increasing.

Lung cancer incidence decreased in males, but increased in females during the period. Laryngeal cancer also decreased in males, but was steady in females. These time trends are consistent with the trends in tobacco smoking in the population over time. Interestingly, there were no time trends in bladder cancer, although tobacco smoking is also a strong risk factor for this cancer.

Spatial Variation: SaTScan software was used to evaluate geographical variation in six cancer groupings and several subtypes over the same 23-year period. Three cancer groupings were evaluated spatially for children under age 20. Evaluation for spatial variation was conducted separately by sex.

No statistically significant clusters were detected using SaTScan software for many cancer groupings evaluated using New Jersey cancer incidence data for the years 1979 – 2001. The cancer groups without statistically significant clusters were: male and female childhood leukemia; male and female childhood acute lymphocytic leukemia; male and female childhood brain and other nervous system cancers; and male and female

bone cancers.

Statistically significant clusters were detected using SaTScan software using New Jersey cancer incidence data for the years 1979 – 2001 for the following cancer groupings: male and female mesothelioma; male and female leukemia; male and female thyroid cancer; male and female brain and other nervous system cancers; and male and female bladder cancer. With the exception of mesothelioma, relative risks within statistically significant clusters were generally 1.5 or below. For melothelioma high relative risk clusters were seen in areas of historic asbestos-related industries.

It is important to note that SaTScan cluster analysis results must be interpreted with caution. SaTScan analyses are sensitive to which options are selected within the software program. Changing the selected parameters may provide varying clustering results, making interpretation difficult and creating obvious ramifications for communication of results.

We found that geocoding success rates for NJ State Cancer Registry cases varied by both time and geographical region in New Jersey. The impact of this differential geocoding case loss, which was especially high in rural areas, has potential consequences in analyses using the data. Future EPHT projects will need to carefully evaluate the completeness of all health outcome datasets, especially if the completeness of the dataset is found to vary geographically.

Introduction

Examination of the spatial patterns in cancer incidence data may reveal opportunities for prevention, particularly if disease patterns coincide with patterns of preventable risk factors. Mapping of cancer mortality or incidence data has occurred for many years. For example, the National Cancer Institute's *Atlas of Cancer Mortality for U.S. Counties: 1950-1969* (Mason et al., 1975), represented the first effort to map cancer mortality on the county level throughout the United States. In these early maps, cancer mortality rates in all or parts of New Jersey were significantly higher than U.S. rates overall and for most cancer types examined. The publication of the NCI's atlas provided the impetus to establish the New Jersey State Cancer Registry (NJSCR) and a cancer epidemiology unit within the NJDHSS.

The NJDHSS has subsequently presented county-level mapping of cancer incidence and mortality data in a series of reports (e.g., Stemhagen et al., 1981; NJDOH, 1989; Roche et al., 1999). Most recently, an interactive mapping tool for New Jersey cancer incidence data at the county level is available on the internet.

Time trends in cancer incidence may also reflect changes in temporal patterns in risk factors. For example, a decline in lung cancer incidence among males reflects decreased cigarette smoking, while rising lung cancer incidence in females reflects increased smoking, taking into account a latency period of decades.

New Jersey is an appropriate setting to examine geographic and temporal comparisons of cancer incidence. Historically, the state has had relatively high incidence or mortality rates of certain cancers. Rates of cancer in New Jersey are generally higher than averaged SEER rates, but are similar to rates in the Northeast region. In 2000, the total age-adjusted cancer incidence rate per 100,000 residents in New Jersey was 623.7 for males and 449.4 for females, compared with rates of 560.2 and 413.8 respectively for 11 SEER Registries combined (NJDHSS, 2004). Rates for many specific cancers including bladder, lung, colorectal, prostate and cervical cancers are high in New Jersey when compared with national incidence data (NJDHSS, 2004). The population resides in urban, suburban, and rural areas. More than 1 million of the state's nearly 8.5 million residents are age 65 or older, and the population is ethnically and racially diverse.

In response to a childhood cancer cluster in Dover Township, New Jersey established a Task Force on Cancer Clusters to evaluate issues related to disease clustering in the state. Recommendations of the Task Force include assessing the feasibility of cancer cluster surveillance based on cancer incidence data on an appropriate geographic and temporal scale in parallel with the development of integrated environmental exposure metrics (NJDHSS, 2004). While the EPHT Project was not designed to fulfill the Task Force's recommendation, it is hoped the lessons learned during this demonstration activity will help inform future state efforts in cancer cluster evaluation.

To determine which cancer types to examine for geographic and temporal

variation, the NJDHSS and NJDEP reviewed the literature, including authoritative evaluations of cancer-causing chemicals by the U.S. Department of Health and Human Services (USDHHS, 2002), the International Agency for Research on Cancer (IARC, 1972-2004). The NJDHSS and NJDEP jointly compiled a list of cancer types based on epidemiologic evidence that environmental factors may play a role in the etiology of the cancer and evidence that exposure to these environmental factors occurs in New Jersey.

Methods

Overview

For temporal variation, annual age-adjusted rates were calculated for 14 cancer groupings and several histological subtypes for males and females from 1979 through 2001. In addition, annual age-adjusted rates were calculated for three cancer groupings for children (under age 20 at time of diagnosis) for the same time period.

Spatial variation of six cancer groupings and several subtypes was conducted using SaTScan software over the same 23-year period. Three cancer groupings were evaluated spatially for younger populations.

Temporal Variation in Cancer Incidence

Selection of Cancer Types for Temporal Analysis

Temporal analyses were conducted for 14 select cancer groupings, plus several subtypes, for all ages combined:

- Leukemias
    - Acute myeloid leukemia
- Non-Hodgkin lymphoma
- Urinary bladder
- Brain and other nervous system
- Liver
    - Angiosarcoma of the liver
- Mesothelioma
- Lung and bronchus
- Thyroid cancer
- Soft tissue sarcoma
- Larynx
- Nasopharynx
- Nose, nasal cavity and middle ear
- Kidney and renal pelvis
- Osteosarcoma

Temporal analyses were also calculated for the following cancers in children (age 0-19 years):

- All Cancers
- Leukemias
- Brain and other nervous system

Temporal Analyses

From the New Jersey State Cancer Registry (NJSCR) database, statewide incidence rates for selected cancers were calculated by sex for each year from 1979 through 2001 over the 23-year period. Rates were age-standardized to the year 2000 U.S. population. For some cancers, separate age-standardized rates were calculated for children (age less than 20). (Of note, at the time that data from the NJSCR was extracted for this analysis, data for 2001 were not yet considered complete.)

Age standardization was accomplished by computing annual age-specific rates for New Jersey (for each of 17 five-year age groups up through age 84 years, and for those aged 85 years or more). Annual sex and age-group population estimates utilized to calculate state rates were supplied by the National Cancer Institutes' Surveillance Epidemiology End Results (SEER) program. Age-specific rates for each year were computed by dividing the number of cases occurring in an age group by the estimated average population size of New Jersey in that age group during that year. An age-standardized rate was then computed as a weighted average of the age specific rates, using the age distribution of the standard population to derive the weighting factors.

Spatial Variation in Cancer Incidence

Selection of Cancer Types for Spatial Analysis

The following cancer types were selected for analysis of spatial variation, for all ages combined:

- Mesothelioma
- Leukemia
- Brain and other nervous system
- Thyroid
- Bladder
- Bone

Spatial analyses were also calculated for the following cancers in age-specific population groups as indicated:

- Leukemia (children under 15 years),
    - Acute lymphocytic leukemia (children under 15 years)
- Brain and other nervous system (children under 15 years)

- Bone (young adults and children under 25 years)

Spatial Analyses

From the database of the NJSCR, analytical databases for selected cancers were constructed. For each cancer type, the database included a line listing of cases identified by sex, age group and race/ethnicity. Each case was geocoded to the street block level and, where possible, assigned to a census tract, municipality and county. The spatial unit of analysis was the x, y centroid of the census tract. Both the 1990 and 2000 census tract codes were provided for each case. Of note, cancer data for the geographic analyses were derived from a later data download than the temporal analyses. Consequently, the total numbers of cases for each cancer type differ between the temporal and geographic analyses.

Population: Population denominators for the spatial analysis were derived from the U.S. Census data for each of New Jersey's census tracts. Two population datasets were developed for comparison for utility in the spatial analysis. The first was a population dataset derived from the 1990 census year (U.S. Census Bureau, 2004) for each of the 1,934 census tracts in the state during that census year. The 1990 population year was used because it is the midpoint of the 23-year evaluation period. Population data by sex and 18 age-specific groups (as specified above) were available for each census tract. In addition, another population dataset was developed using data from 1980, 1990 and 2000 census years normalized to each of the 1,950 census tracts in the 2000 census year. The normalized population data were developed by Geolytics, Inc. (2003). The population data used in the second data set include sex and 12 age groups (seven five-year age groups up through age 34 years, four ten-year age groups from age 35 through age 74, and for those aged 75 years or more).

Case Data: For the cancer types selected for spatial geographic analysis, separate electronic data files were prepared by the NJSCR and transmitted securely to CEHS. All cancer cases were assigned to a 1990 and 2000 census tract based on residence at time of diagnosis. Select demographic characteristics were reviewed and summarized for the entire state dataset by cancer type. Each cancer type was evaluated for its completeness in terms of geocoding to the census tract for each case. In these spatial analyses, only cases geocoded to the census tract using the entire residential address were used.

Statistical Analysis of Clustering and Mapping: SaTScan software was used for spatial analysis in order to examine possible clustering of elevated rates. SaTScan (Kulldorff et al., 1998; 2004) was used to test the null hypothesis of complete spatial randomness against the alternative hypothesis that the probability of being a case in zone z is greater than the probability of being a case outside that zone (Hjalmars et al., 1996; Kulldorff, 1997). Zones of aggregated cells were constructed by allowing the radii of circles to vary continuously according to pre-determined parameters. The maximum spatial cluster size used was 50% of the population at risk. Standardized incidence ratios (SIRs) by sex for the years 1979-2001 were calculated and were mapped using ArcView

9 geographic information system (GIS) software. SatScan identifies the "most likely" cluster as well as "secondary" clusters. All statistically significant ($p<0.05$) clusters, both most likely and secondary are shaded in dark red with non-statistically significant clusters shaded in light blue.

Space-time, Intra-period, and SIR Mapping: To explore clustering results further, male mesothelioma was evaluated for: 1) space-time clustering through the 23-year observation period; 2) four discrete intra-periods of five or six years each; and 3) the impact of limiting the maximum population at risk allowed in any given cluster. In addition, the pattern clustering was compared to a map of census tract SIRs.

Evaluation of Non-geocoded Cases: Cases that were unable to be geocoded to a census tract were evaluated for geographic (by county) patterns of loss and time trend effects of the loss.

Results

Temporal Analyses

Leukemia: A total of 12,544 males and 10,113 females were diagnosed with leukemia during the 23-year period. Annual age-adjusted leukemia rates (Table 1 and Graph 1) tended to be 50% or higher each year for males than females. For males, annual rates ranged from 14.4 per 100,000 population to 18.1 per 100,000 population. For females, annual rates ranged from 8.8 per 100,000 population to 11.1 per 100,000 population. *There were no discernible trends through time in annual leukemia rates for either sex.*

Acute Myeloid Leukemia: A total of 3,008 males and 2,628 females were diagnosed with acute myeloid leukemia (AML) during the 23-year period, representing 24% and 26% of all leukemia cases for males and females respectively. Annual age-adjusted AML rates (Table 2) tended to be slightly higher each year for males than females. For males, annual rates ranged from 3.0 per 100,000 population to 5.1 per 100,000 population. For females, annual rates ranged from 1.7 per 100,000 population to 3.7 per 100,000 population. *There were no discernible trends through time in annual AML rates for either sex.*

Non-Hodgkin Lymphoma: A total of 17,021 males and 15,618 females were diagnosed with non-Hodgkin lymphoma during the 23-year period. Annual age-adjusted non-Hodgkin lymphoma rates (Table 3 and Graph 2) tended to be 50% or higher each year for males than females. For males, annual rates ranged from 16.0 per 100,000 population to 27.2 per 100,000 population. For females, annual rates ranged from 11.1 per 100,000 population to 19.6 per 100,000 population. *Rates for both sexes appear to be increasing steadily through time.*

Urinary Bladder Cancer: A total of 33,565 males and 12,475 females were

diagnosed with bladder cancer during the 23-year period. Annual age-adjusted bladder cancer rates (Table 4 and Graph 3) were three to four times higher each year for males than females. For males, annual rates ranged from 43.1 per 100,000 population to 50.1 per 100,000 population. For females, annual rates ranged from 10.8 per 100,000 population to 12.8 per 100,000 population. *There were no discernible trends through time in annual bladder cancer rates for either sex.*

Brain and Other Nervous System Cancers: A total of 6,903 males and 5,956 females were diagnosed with brain or other nervous system cancers during the 23-year period. Annual age-adjusted brain cancer rates (Table 5 and Graph 4) were slightly higher each year for males than females. For males, annual rates ranged from 7.3 per 100,000 population to 9.3 per 100,000 population. For females, annual rates ranged from 4.7 per 100,000 population to 7.3 per 100,000 population. *There were no discernible trends through time in annual brain or other nervous system cancer rates for either sex.*

Liver Cancer: A total of 3,999 males and 1,850 females were diagnosed with liver cancer during the 23-year period. Annual age-adjusted liver cancer rates (Table 6) were slightly higher each year for males than females. For males, annual rates ranged from 2.9 per 100,000 population to 8.6 per 100,000 population. For females, annual rates ranged from 1.2 per 100,000 population to 2.5 per 100,000 population. *Annual liver cancer rates increased through the time period for both sexes, but more than doubled for males.*

Angiosarcoma of the Liver: A total of 19 males and 14 females were diagnosed with angiosarcoma during the 23-year period. Because of the relatively few cases, annual age-adjusted angiosarcoma rates and numbers are not presented. *There was no discernible trend in the incidence of angiosarcoma of the liver through time.*

Mesothelioma: A total of 2,316 males and 531 females were diagnosed with mesothelioma during the 23-year period. Annual age-adjusted mesothelioma rates (Table 7 and Graph 5) were higher for males than females each year. For males, annual rates ranged from 1.6 per 100,000 population to 3.7 per 100,000 population. For females, annual rates ranged from 0.2 per 100,000 population to 0.7 per 100,000 population. *There were no discernible trends through time in annual mesothelioma rates for either sex.*

Lung and Bronchus Cancer: A total of 78,971 males and 51,100 females were diagnosed with lung and bronchus cancer during the 23-year period. Annual age-adjusted lung cancer rates (Table 8) were substantially higher for males than females each year. However, *annual male lung cancer rates dropped about 25% through the time period while female rates increased about 50% during the same time.* For males, annual rates ranged from 84.2 per 100,000 population to 115.4 per 100,000 population. For females, annual rates ranged from 36.1 per 100,000 population to 56.2 per 100,000 population.

Thyroid Cancer: A total of 2,582 males and 7,293 females were diagnosed with

thyroid cancer during the 23-year period. Annual age-adjusted thyroid cancer rates (Table 9 and Graph 6) were higher for females than males each year. *Rates in females showed a dramatic increase (by nearly three-fold) during the period; rates in males also increased, but to a lesser extent.* For males, annual rates ranged from 1.7 per 100,000 population to 5.2 per 100,000 population. For females, annual rates ranged from 4.4 per 100,000 population to 14.4 per 100,000 population.

Soft Tissue Sarcoma: A total of 396 males and 444 females were diagnosed with soft tissue sarcoma during the 23-year period. *Annual age-adjusted soft tissue sarcoma rates* (Table 10) *were relatively stable for both sexes through time.* For males, annual rates ranged from 0.3 per 100,000 population to 0.9 per 100,000 population. For females, annual rates ranged from 0.2 per 100,000 population to 0.7 per 100,000 population.

Laryngeal Cancer: A total of 8,195 males and 2,095 females were diagnosed with laryngeal cancer during the 23-year period. Annual age-adjusted laryngeal cancer rates (Table 11) were four to six times higher for males than females each year. *Annual male laryngeal cancer rates decreased by about 50% through the time period while female laryngeal cancer rates remained relatively stable.* For males, annual rates ranged from 7.6 per 100,000 population to 12.6 per 100,000 population. For females, annual rates ranged from 1.6 per 100,000 population to 2.4 per 100,000 population.

Nasopharyngeal Cancer: A total of 848 males and 424 females were diagnosed with nasopharyngeal cancer during the 23-year period. *Annual age-adjusted nasopharyngeal cancer rates* (Table 12) *were relatively stable for both sexes through time.* For males, annual rates ranged from 0.8 per 100,000 population to 1.4 per 100,000 population. For females, annual rates ranged from less than 0.0 per 100,000 population to 0.7 per 100,000 population.

Nose, Nasal Cavity and Middle Ear Cancer: A total of 773 males and 592 females were diagnosed with nose, nasal cavity or middle ear cancer during the 23-year period. *Annual age-adjusted nose, nasal cavity and middle ear cancer rates (Table 13) were relatively stable for both sexes through time.* For males, annual rates ranged from 0.7 per 100,000 population to 1.4 per 100,000 population. For females, annual rates ranged from 0.4 per 100,000 population to 0.8 per 100,000 population.

Kidney and Renal Pelvis: A total of 12,533 males and 7,897 females were diagnosed with kidney and renal pelvis cancer during the 23-year period. Annual age-adjusted kidney and renal pelvis cancer rates (Table 14) were nearly twice as high for males than females each year. *Annual kidney and renal pelvis cancer rates increased by nearly 50% through the time period for both sexes.* For males, annual rates ranged from 12.3 per 100,000 population to 19.2 per 100,000 population. For females, annual rates ranged from 5.3 per 100,000 population to 9.6 per 100,000 population.

Osteosarcoma: A total of 323 males and 236 females were diagnosed with osteosarcoma during the 23-year period. *Annual age-adjusted osteosarcoma rates* (Table 15) *were relatively stable for both sexes through time.* For males, annual rates ranged

from 0.2 per 100,000 population to 0.6 per 100,000 population. For females, annual rates ranged from 0.1 per 100,000 population to 0.4 per 100,000 population.

Childhood Cancer: Childhood cancer was evaluated for persons diagnosed under age 20 for all cancers combined, leukemia, and brain and other nervous system cancers. A total of 8,545 children were diagnosed with some form of reportable cancer during the 23-year period. Leukemia accounted for 24.9% of all childhood cancer, a total of 2,131 cases during the observation period. Brain and other nervous system cancers accounted for 17.4% of all childhood cancer, a total of 1,485 cases during the observation period. *Annual age-adjusted rates for all cancer combined, leukemia, and brain and other nervous system cancers* (Table 16 and Graphs 1 and 4) *were relatively stable for each cancer grouping through time.* For all cancers combined, annual rates ranged from 15.1 per 100,000 population to 19.5 per 100,000 population. For leukemia, annual rates ranged from 3.6 per 100,000 population to 5.0 per 100,000 population. For brain and other nervous system cancers, annual rates ranged from 2.4 per 100,000 population to 3.9 per 100,000 population.

Spatial Analyses

Mesothelioma: A total of 2,871 mesothelioma cases were identified for the period 1979-2001. Of these, 2,463 (85.8%) had a valid 1990 census tract designation, of which 81.2% were males. SaTScan identified two statistically significant clusters for males and one for females using the 1990 census tract designations and the 1990 population denominators. The SIR for the most likely male cluster was 17.2 (p=0.001) and the SIR for the most likely female cluster was 14.9 (p=0.001), both occurring in the Manville, Somerset County area. SaTScan also identified one statistically significant secondary cluster for males with an SIR of 1.9 (p=0.001). The secondary cluster was a geographically large area covering parts of Camden, Burlington, and Gloucester counties. Non-statistically significant clusters were also identified, including two in males and seven in females.

Using the 2000 census tract codes, a total of 2,516 mesothelioma cases (87.6%) had a valid census tract designation, of which 81.3% were males. SaTScan analyses using the 2000 census tracts and the 1980, 1990, and 2000 populations normalized to the 2000 census tracts found similar results to the analyses using the 1990 tracts and population. For both males and females, the most likely clusters occurred in the Manville, Somerset County, area with a male SIR of 17.2 (p=0.001) and a female SIR of 14.8 (p=0.001). A large statistically significant secondary cluster for males was also found covering parts of Camden, Burlington, and Gloucester counties, with an SIR of 1.9 (p=0.001). Non-statistically significant clusters identified include one in males and five in females.
Because of the similarity of results, only the results using the 2000 census tracts are presented in Figures 1 and 2.

Leukemia: A total of 22,928 leukemia cases were identified for the period 1979-2001. Of these, 18,334 (80.0%) had a valid 1990 census tract designation, of which

56.2% were males. SaTScan identified two geographically large and statistically significant clusters, one for males and one for females, using the 1990 census tract designations and the 1990 population denominators. The SIR for the most likely male cluster was 1.2 (p=0.001) and the SIR for the most likely female cluster was 1.1 (p=0.001), both occurring over a large area in the northeastern part of the state. SaTScan also identified one statistically significant secondary cluster for males with an SIR of 6.8 (p=0.016), located in one census tract in Middlesex County. Non-statistically significant clusters were also identified, including four in males and six in females.

Using the 2000 census tract codes, a total of 18,383 leukemia cases (80.2%) had a valid census tract designation, of which 56.2% were males. SaTScan analyses using the 2000 census tracts and the 1980, 1990, and 2000 populations normalized to the 2000 census found similar results to the analyses using the 1990 tracts and population. For both males and females, the most likely clusters occurred in a large area in northeastern part of the state, with a male SIR of 1.2 (p=0.001) and a female SIR of 1.1 (p=0.001). A small secondary cluster for females was also found in Monmouth County, with an SIR of 2.5 (p=0.013). Four non-statistically significant clusters were identified in males, and five in females. Because of the similarity of results, only the results using the 2000 census tracts are presented in Figures 3 and 4.

Childhood (under age 15 at time of diagnosis) leukemia and acute lymphocytic leukemia were also evaluated separately for males and females using the 2000 census tracts and the 1980, 1990, and 2000 populations normalized to the 2000 census. Of the total 18,383 leukemia cases with a valid 2000 census tract designation, 8.3% were in children, with 77.5% of all childhood leukemia due to acute lymphocytic leukemia. Slightly more male children (55.7%) were diagnosed with leukemia than female children. While no statistically significant clusters were detected for childhood leukemia, a number of non-statistically significant clusters were identified for boys (seven) and girls (seven) and are presented in Figures 5 and 6.

For childhood acute lymphocytic leukemia, one statistically significant cluster was detected among boys in Beachwood Boro with an SIR of 8.7 (p=0.043). No statistically significant clusters were detected for females, but several non-statistically significant clusters were identified, ten for boys and eleven for girls. Results for childhood acute lymphocytic leukemia are presented in Figures 7 and 8.

Thyroid Cancer: A total of 9,952 thyroid cancer cases were identified for the period 1979-2001. Of these, 8,861 (89.0%) thyroid cases had a valid 1990 census tract designation, of which 73.7% were females. SaTScan identified two statistically significant clusters for males using the 1990 census tract designations and the 1990 population denominators. The SIR for the most likely male cluster was 1.2 (p=0.003) and the SIR for the secondary male cluster was 1.5 (p=0.013). For females, three statistically significant clusters were detected. The SIR for the most likely female cluster was 1.4 (p=0.001) and the SIRs for the two secondary female clusters were 1.4 (p=0.001) and 1.4 (p=0.013). All of these clusters were in the northern part of the state and are presented in Figures 9 and 10. Non-statistically significant clusters were also identified,

including four in males and five in females.

Using the 2000 census tract codes, a total of 8,890 thyroid cancer cases (89.3%) had a valid census tract designation, of which 73.8% were females. SaTScan analyses using the 2000 census tracts and the 1980, 1990, and 2000 populations normalized to the 2000 census found similar results to the analyses using the 1990 tracts and population. The SIR for the most likely male cluster was 1.2 (p=0.001) and the SIR for the secondary male cluster was 1.6 (p=0.008). For females, four statistically significant clusters were detected. The SIR for the most likely female cluster was 1.4 (p=0.001) and the SIRs for the three secondary female clusters were 1.3 (p=0.002), 1.5 (p=0.002), and 103 (p=0.034). This last secondary cluster was in one census tract, had very few cases, and was not identified using only the 1990 populations. All of these clusters were in the northern part of the state. Non-statistically significant clusters were identified as well, including three in males and five in females.

Two subtypes of thyroid cancer were evaluated separately, papillary and follicular. Of the 8,861 thyroid cases with a valid 1990 census tract designation, 70.9% were papillary and 17.0% were follicular. As with the overall cases of thyroid cancer, nearly three-quarters of each subtype were females. The most likely papillary clusters identified for males and females were geographically overlapping in the northern part of the state. The SIR for the most likely male papillary cluster was 1.4 (p=0.001) and the SIR for the most likely female papillary cluster was 1.4 (p=0.001). SaTScan also identified two statistically significant secondary clusters for female papillary thyroid cancer. Both secondary clusters were in northeastern New Jersey with SIRs of 1.4 (p=0.045) and 85 (p=0.047). This last secondary cluster was in one census tract and had very few cases. For follicular thyroid cancer, the SIR for the most likely male cluster was 1.8 (p=0.028) and the SIR for the most likely female cluster was 1.6 (p=0.001), both overlapping in the central part of the state. Several non-statistically significant clusters were also identified, including two for follicular and five for papillary in males and three for follicular and four for papillary in females.

Brain and Other Nervous System Cancers: A total of 12,919 brain and other nervous system cancer cases were identified for the period 1979-2001. Of these, 10,502 (81.3%) cases had a valid 2000 census tract designation, of which 54.1% were males. Because of the similarity in earlier results using both the 1990 and 2000 census tracts, this evaluation only used the 2000 coding. The SIR for the most likely male cluster was 1.2 (p=0.001) and the most likely female cluster was 1.2 (p=0.001). One statistically significant secondary cluster was detected for females, with an SIR of 1.5 (p=0.006). Each of these clusters was in the northeastern part of the state and are presented in Figures 11 and 12. Non-statistically significant clusters identified include eight in males and six in females.

Childhood (under age 15 at time of diagnosis) brain and other nervous system cancer was also evaluated separately for males and females. Of the total 10,502 brain and other nervous system cancer cases with a valid 2000 census tract designation, 10.1% were in children, with male children accounting for 54.4% of all cases if childhood brain

and other nervous system cancers. No statistically significant clusters were detected for childhood brain and other nervous system cancers. Non-statistically significant clusters identified include seven in males and five in females. Figures 13 and 14 present the SaTScan results for childhood brain/ONS cancers.

Bone Cancer: A total of 1,908 bone cancer cases were identified for the period 1979-2001. Of these, 1,599 (83.8%) cases had a valid 2000 census tract designation, of which 54.3% were males. No statistically significant clusters were detected for bone cancer for either males or females. Non-statistically significant clusters identified include three in males and eleven in females. Figures 15 and 16 present the SaTScan results for bone cancer.

Childhood/young adult (under age 25 at time of diagnosis) bone cancer was also evaluated separately for males and females. Of the total 1,599 bone cancer cases with a valid 2000 census tract designation, 30.4% were under age 25, and 60.1% of these males. No statistically significant clusters were detected for childhood/young adult bone cancer. Non-statistically significant clusters identified include three in males and two in females.

Bladder Cancer: A total of 46,142 bladder cancer cases were identified for the period 1979-2001. Of these, 40,085 (86.9%) cases had a valid 2000 census tract designation, of which 73.1% were males. The SIR for the most likely male cluster was 1.1 (p=0.001) and the SIR for the most likely female cluster was 1.3 (p=0.001), both occurring in the northeastern part of the state. Six statistically significant secondary clusters were identified for male bladder cancer: SIR of 1.2 (p=0.001) in southern Ocean and Burlington counties; SIR of 1.2 (p=0.001) in southern Union and northern Middlesex counties; SIR of 1.2 (p=0.001) in Middlesex and northern Monmouth counties; SIR of 1.3 (p=0.001) in northern Camden and Gloucester counties; SIR of 1.3 (p=0.006) in southern Mercer county, and SIR of 1.4 (p=0.009) in Camden and Burlington counties. No statistically significant secondary clusters were identified for female bladder cancers. Non-statistically significant clusters identified include six in males and seven in females. Figures 17 and 18 present the male and female bladder cancer clusters.

Space-time, Intra-period, and SIR Mapping: Male mesothelioma was used to further evaluate temporal clustering and SIR mapping. SaTScan was rerun using the space-time analysis feature. The SIR for the most likely cluster was 15.9 (p=0.001) for the period 1979 through 1989 in the Manville area, Somerset County. Two statistically significant secondary clusters were also identified. The secondary clusters include a large area in Camden, Gloucester, and Burlington counties with an SIR of 2.4 (p=0.001) for the time period 1982 through 1992 and a large area in Middlesex, Monmouth, and Union counties with an SIR of 2.1 (p=0.010) for the time period 1992 through 1996. Two non-statistically significant clusters were also found. The space-time clusters are presented in Figure 19.

As another approach to evaluating clusters through time, four time periods (1979-1983, 1984-1989, 1990-1995, and 1996-2001) were selected for spatial analysis of clustering of male mesothelioma. In the 1979-1983 period, the only statistically

significant cluster identified was in the Manville area, Somerset County, with an SIR of 19.8 (p=0.001). For the 1984-1989 period, two statistically significant clusters were identified and include the Manville area with an SIR of 17.6 (p=0.001) and a large area in Camden, Gloucester, and Burlington counties with an SIR of 2.1 (p=0.001). For the 1990-1995 period, two statistically significant clusters were identified and include the Manville area with an SIR of 8.5 (p=0.001) and a large area in Camden, Gloucester, Salem, and Burlington counties with an SIR of 2.0 (p=0.001). For the 1996-2001 period, two statistically significant clusters were identified and include the Manville area with an SIR of 21.1 (p=0.001) and a large area in Camden, Gloucester, Atlantic, and Burlington counties with an SIR of 1.9 (p=0.001). Figures 20 through 23 present the time period cluster analyses.

To further explore cluster results, male mesothelioma was reanalyzed by limiting the maximum population at risk allowed in any given cluster. Figure 24 presents these results. The SIR for the most likely cluster was 17.2 (p=0.001) in the Manville area. Four statistically significant secondary clusters were also identified. A large secondary cluster was detected just west of Manville with an SIR of 2.4 (p=0.004). Three smaller clusters in Camden County with SIRs of 3.8 (p=0.001), 3.1 (p=0.001) and 2.2 (p=0.037). Eight non-statistically significant clusters were also found. The three statistically significant clusters in Camden County along with three non-statistically significant clusters in the County provide a sharper image of the very large cluster identified in Figure 1 when up to 50% of the population at risk was permitted to be included in any one cluster.

SaTScan calculated male mesothelioma SIRs for each census tract in the state over the 23-year evaluation period. The SIRs were mapped by four categories (0-1.0, 1.1-2.0, 2.1-3.5, and 3.6+) and presented in Figure 25. Comparing Figure 25 with Figure 1, the male mesothelioma cluster map, the underlying census tracts of the cluster in the southern part of the state is made up of a patchwork of varying SIR levels. The incidence of mesothelioma in census tracts within the cluster display low to high risk. This provides further evidence that in geographically large clusters, which allow higher percents of the population at risk, the exact boundary is less important and likely provides only a general area of the increased risk.

Evaluation of Non-geocoded Cases: Evaluation of the geographic and time period loss of cases due to the inability to geocode accurately to a census tract was done using the leukemia data and the 2000 census tract coding. Out of a total 22,928 cases from 1979 through 2001, 4,545 cases (19.8%) statewide could not be geocoded to a census tract. Reporting source for cases displayed variation for loss: 11.9% for hospital inpatient, 12.9% for laboratory only, 21.4% for autopsy only, and 96.3% for death certificate only. The NJSCR did not begin entering address information from the death certificate into the Registry until the late 1990s, which accounts for the large percentage of lost cases for spatial analysis.

Table 17 presents a breakdown of the leukemia cases by county of residence at time of diagnosis. The smallest percentage of loss was from Essex County (12.8%) while

the largest percentage of loss was from Salem County (45.7%). In general, more rural counties tended to have higher percentage of cases which could not be geocoded. The percentage of cases not able to be geocoded dropped through time (Table 18 and Figures 26 and 27), with 27.2% statewide lost from 1979-1990 and 12.8% statewide lost from 1991-2001. During the earlier time period, the greatest percentage of non-geocoded cases was seen in Salem (65.3%) and Hunterdon (59.2%) counties. Since 1991, all counties had substantially fewer cases not geocoded than the earlier period, with a loss range from 8.6% in Essex to 27.9% in Salem. Factors that appear to be responsible for this decrease include elimination of rural route addresses statewide and fewer death certificate-only cases through time.

Discussion

Interpretation of Findings: Time Trends

In New Jersey, the incidence rates of many of the cancer types examined for this demonstration project have been steady over the period 1979 through 2001. These cancer types of interest to EPHT include: leukemia, urinary bladder cancer, brain and other central nervous system cancer, mesothelioma, soft tissue sarcoma, nasopharyngeal cancer, cancer of the nose, nasal cavity and middle ear, and osteosarcoma. The incidence rates of cancer among children were stable over the period, for all cancers combined and for leukemia and brain and other nervous system cancers, the two most common types of cancer in children.

The incidence rates for certain cancer types increased over the period. Thyroid cancer increased in both sexes, but especially in females. Rates of non-Hodgkin lymphoma, liver cancer, and kidney cancer also increased in both sexes. However, rates of the rare angiosarcoma of the liver, which is associated with occupational exposure to vinyl chloride, did not appear to be increasing.

Lung cancer incidence decreased in males, but increased in females during the period. Laryngeal cancer also decreased in males, but was steady in females. These incidence time trends are consistent with the trends in tobacco smoking in the population over time. Interestingly, there were no time trends in bladder cancer, although tobacco smoking is also a strong risk factor for this cancer.

In general, the time trends observed in New Jersey over the period 1979-2001 are consistent with trends observed nationally.

Interpretation of Findings: Spatial Clustering

Evaluating hypotheses by identifying specific localized clusters is an approach that too frequently can lead to a high rate of false positive results, particularly when based on a small number of cases (Rothman, 1990). Consequently, we selected a spatial scan statistic, using SaTScan, to systematically identify geographic clustering statewide using

cancer data. SaTScan has been used in many similar spatial epidemiological investigations (SaTScan, 2006). A recent simulation study of disease cluster methods found that SaTScan was preferable for detection of lower relative risks than the other methods (Aamodt et. al, 2006)

Mesothelioma is a very rare type of cancer. Mesothelioma incidence is higher in the New Jersey than nationally and it is not uniformly distributed throughout the state. Somerset County, New Jersey, has long been considered an area that had unusually high mesothelioma rates (Berry, 1997). The use of mesothelioma to test SaTScan's methods was meant to be a positive control for detecting clustering in the state.

New Jersey has traditionally been the center of operations for many asbestos products manufacturers and shipyards. For nearly 70 years in the early to late 20th Century, Manville, Somerset County, was the location of the largest asbestos products manufacturing plant in North America, employing up to 3,500 people at one time. Because mesothelioma incidence is so strongly associated with asbestos exposure and the knowledge that mesothelioma rates were high in the Manville area, mesothelioma was selected to be the most likely cancer type to test the utility of spatial clustering techniques.

SaTScan was able to detect two areas with traditionally high potential asbestos exposure. As expected, the first area was in the vicinity of Manville in Somerset County. SIR estimates were extremely high, on the order of 15 to 20-times higher than expected. These SIRs were far higher than SIRs for mesothelioma in other areas or any other cancer type anywhere in the state, excluding areas with very small observed and extremely small expected number of cases. The other area with significantly higher mesothelioma SIRs was in the Camden County area which historically was the center of shipbuilding and repair. These SIRs were generally around twice the expected or less.

SaTScan evaluation of other cancer types showed variable clustering from relatively small geographic areas to large portions of the state. In general, the SIRs for these clusters were relatively modest compared to the results for mesothelioma.

Two different methods were used to calculate the underlying population at risk for the spatial analyses. For each census tract, age-sex specific population denominators were derived using 1) only the 1990 census data and 2) 1980, 1990 and 2000 population data. The comparative analyses in cancer types selected found little evidence that either method was better. While the number of census tracts for 1990 and 2000 differed, the clusters detected were located in the same general geographic area.

The impact of the completeness of geocoding of the cases was evaluated to determine the effect on the SaTScan results. Between 80% to 90% of the cases were able to be geocoded using their entire address and were used in the SaTScan analysis. A large percentage of the cases lost from the analysis were identified to the SCR via searches of death certificate records. Those cases, while entered into the SCR records, historically did not have address information included in the record. In the middle to late 1990s,

death certificate address information began to be included in the SCR database. In addition, for non-death certificate cancer cases, a geographic bias in loss due to lack of adequate address information was evident for more rural counties in the state. It was also evident that this loss was more severe in the earlier years of the SCR, decreasing towards the present time. The impact from case loss due to non-geocoded addresses may have important potential consequences in the SaTScan analyses, particularly given the space-time differential of loss, and the size of loss. For leukemais, there was an overall case loss of about 20%, but this proportion varied from 17% to 61% among counties in the 1979-1990 period, and 9% to 28% among counties in the 1991-2002 period. Future analysis should take this loss into consideration, and exclude death certificate cases from the evaluation.

It is important to note that SaTScan did not detect a statistically significant cluster for childhood leukemia in Toms River, Ocean County, in the period 1979-2001. Previously, a significant cluster (particularly for female leukemia) was identified for the periods 1979-1995 and 1979-2000, using different methods for a pre-identified geographic area of concern (Berry and Haltmeier, 1997; Berry et. al 2003). However, SaTScan did find non-statistically significant clusters for female childhood leukemia (SIR=2.9) and acute lymphocytic leukemia (SIR=3.4) in the same area. The discrepancy raises questions about the sensitivity of SaTScan to detect local clustering.

Lessons Learned from Demonstration Project

The quality and completeness of the geographic information for health outcome data is an important consideration in successfully using these data for descriptive analysis of geographic patterns. Loss of data because it cannot be geocoded accurately may have a substantial impact on the data's potential use and accuracy of the results. This is especially true for important older historic data requiring additional preparation time to more accurately geocode questionable data.

Determination of the appropriate geographic scale (latitude/longitude, census block group, census tract, municipality, etc) for each health outcome dataset must be made prior to use. This scale may vary depending on the purpose of the analysis.

Additional analysis is needed before SatScan or other proactive surveillance methods are used to routinely assess spatial variation in cancer incidence. Strong small-area clustering was identified for mesothelioma, as expected, but not for other cancers. Many clusters found for other cancers covered large areas of the state with populations of relatively low increased relative risk and likely containing heterogeneity within the identified cluster areas. Adjusting the maximum population at risk can provide for a more focused approach. SaTScan detects space-time clusters using cylindrical windows with a circular geographic base and a height of the cylinder corresponding to a certain time interval. Other cluster shapes may be more appropriate than a circular geographic base model for the disease being modeled and the analysis goals (Iyengar, 2005).

SaTScan cluster analysis results are sensitive to which options are selected within

the software program. Changing the parameters may provide varying clustering results making interpretation difficult and creating obvious ramifications for communication of results.

References

Aamodt G, Samuelsen SO, and Skrondal A. A simulation study of three methods for detecting disease clusters. International J of Health Geographics, 5:15, 2006.

Berry M, Haltmeier P, and Fagliano J. Childhood Cancer Incidence Update: A Review and Analysis of Cancer Registry Data, 1979-2000, for Dover Township, Ocean County, New Jersey. New Jersey Department of Health and Senior Services, Trenton, New Jersey, 2003.

Berry M and Haltmeier P. Childhood Cancer Incidence Health Consultation: A Review and Analysis of Cancer Registry Data, 1979-1995, for Dover Township, Ocean County, New Jersey. New Jersey Department of Health and Senior Services, Trenton, New Jersey, 1997.

Berry M. Mesothelioma incidence and community asbestos exposure. Environmental Research, 75(1): 34-40, 1997.

Geolytics. Neighborhood Change Database. The Urban Institute, Washington, D.C., 2003.

Hjalmars U, Kulldorff M, Gustafsson G, Nagarwalla N. Childhood leukemia in Sweden: using GIS and a spatial scan statistic for cluster detection. Statistics in Medicine 15:707-715. 1996.

IARC, 1972-2004. IARC Monographs on the Evaluation of Carcinogenic Risks to Humans and their Supplements: A complete list. Web site: http://monographs.iarc.fr/monoeval/allmonos.html. September 15, 2004.

Iyengar, VS. Space-time clusters with flexible shapes. MMWR, 54(Suppl): 71-76, 2005.

Kulldorff M and and Information Management Services Inc. SaTScan™ v5.1 Software for the Spatial and Space-time Scan Statistics. http://www.SaTScan.org, 2004.

Kulldorff M, Rand K, Ghermanm G, Williams G, DeFrancesco D. SaTScan, version 5.1. NIH, National Cancer Institute. Bethesda, MD, 1998.

Kulldorff M. A spatial scan statistic. Communications in Statistics: Theory and Methods 26 1781-1496. 1997.

Mason TJ, McKay FW, Hoover R, Blot WJ, and Fraumeni JF. Atlas of Cancer Mortality for U.S. Counties, 1950-1969. Department of Health, Education and Welfare Publication, 78-780. U.S. Government Printing Office. Washington, DC, 1975.

NJDHSS. Task Force on Cancer Clusters in New Jersey: A Report to the Commissioner, New Jersey Department of Health and Senior Services. Trenton, NJ, April 2004.

New Jersey Department of Health. The Most Frequent Cancers in New Jersey: Incidence and Mortality Rates by County, Race, and Sex, 1979-1985, Volume 2. Cancer Registry Program, Trenton, NJ, 1989.

Roché L, Cahoon C, Klotz J, Abe T. Cancer Incidence by County, New Jersey, 1986-1996. NJ Dept. of Health and Senior Services, Trenton, NJ. 1999.

Rothman KL. A sobering start for the cluster busters' conference. Am J Epidemiol 132(suppl):S6-13, 1990.

SaTScan Bibliography. http://www.satscan.org/references.html, 2006.

Stemhagen A, Mogielnicki A, Altman R, and Mason T. Descriptive Epidemiology of Cancer Mortality in New Jersey: 1949-1976. NJDHSS. Trenton, NJ, 1981.

U.S. Census Bureau; Census 1990, Summary File 1; generated by Michael Berry; using American FactFinder; <http://factfinder.census.gov>; 2004.

U.S. Department of Health and Human Services. Tenth Report on Carcinogens. Public Health Service, National Toxicology Program, 2002.

Tables, Graphs, and Figures

Table 1. Annual leukemia incidence counts and rates per 100,000 by sex, 1979-2001, New Jersey. Rates age-adjusted to the U.S. 2000 population standard.

Year of	Male		Female	
Diagnosis	Rate	Count	Rate	Count
1979	17.6	501	9.6	374
1980	16.2	476	9.8	391
1981	17.6	514	10.1	396
1982	16.9	505	9.6	385
1983	16.2	498	9.9	409
1984	18.1	539	9.9	409
1985	15.6	483	10.0	417
1986	16.1	499	9.9	416
1987	17.9	569	9.7	421
1988	16.0	518	10.0	436
1989	16.5	532	9.9	435
1990	17.8	581	10.6	470
1991	17.3	569	10.4	462
1992	16.3	552	10.7	489
1993	16.9	577	11.1	504
1994	17.3	588	9.5	445
1995	16.1	555	10.4	493
1996	17.0	600	10.0	474
1997	16.2	590	10.1	485
1998	16.3	597	9.3	449
1999	16.1	583	9.3	453
2000	14.4	533	9.5	465
2001*	15.7	585	8.8	435
1979-2001		12,544		10,113

Data are from the New Jersey State Cancer Registry, Cancer Epidemiology Services, New Jersey Department of Health and Senior Services.
* Data for 2001 are preliminary.

Table 2. Annual acute myeloid leukemia* incidence counts and rates per 100,000 by sex, 1979-2001, New Jersey. Rates age-adjusted to the U.S. 2000 population standard.

Year of	Male		Female	
Diagnosis	Rate	Count	Rate	Count
1979	3.5	101	2.2	86
1980	3.5	106	1.8	72
1981	3.2	97	2.1	83
1982	3.0	88	1.7	71
1983	3.4	98	2.3	93
1984	3.9	121	2.2	88
1985	3.1	94	2.3	97
1986	3.3	102	2.5	106
1987	3.8	125	1.9	80
1988	3.5	117	2.4	106
1989	3.6	117	2.3	98
1990	3.7	120	2.2	96
1991	3.6	124	2.4	106
1992	3.1	108	2.4	111
1993	4.1	142	2.8	128
1994	4.5	158	3.0	142
1995	4.5	156	3.2	148
1996	4.9	173	3.7	176
1997	5.0	184	2.9	141
1998	4.3	164	3.0	144
1999	4.8	173	3.0	145
2000	4.0	149	3.0	148
2001**	5.1	191	3.3	163
1979-2001		3,008		2,628

Data are from the New Jersey State Cancer Registry, Cancer Epidemiology Services, New Jersey Department of Health and Senior Services.
* Acute Myeloid Leukemia includes the following histologic sites; 9840, 9861, 9866, 9867, 9871-9874, 9895-9897, and 9910,9920.
** Data for 2001 are preliminary.

Table 3. Annual non-Hodgkin lymphoma incidence counts and rates per 100,000 by sex, 1979-2001, New Jersey. Rates age-adjusted to the U.S. 2000 population standard.

Year of	Male		Female	
Diagnosis	Rate	Count	Rate	Count
1979	17.4	518	11.6	460
1980	16.2	496	11.2	452
1981	16.7	518	11.1	453
1982	16.0	513	12.1	501
1983	18.0	558	13.2	553
1984	17.8	568	11.8	492
1985	18.5	589	12.3	537
1986	19.2	621	14.0	590
1987	19.2	635	13.8	598
1988	19.6	658	13.8	615
1989	21.9	714	14.9	658
1990	22.3	757	14.5	649
1991	22.0	762	15.4	690
1992	22.3	779	14.9	680
1993	23.1	806	16.4	750
1994	24.4	865	16.9	787
1995	25.4	914	17.3	809
1996	26.7	954	17.6	833
1997	25.2	919	19.3	929
1998	27.2	1,007	19.6	956
1999	25.5	952	17.8	883
2000	24.9	934	17.8	880
2001*	26.3	984	17.4	863
1979-2001		17,021		15,618

Data are from the New Jersey State Cancer Registry, Cancer Epidemiology Services, New Jersey Department of Health and Senior Services.
* Data for 2001 are preliminary.

Table 4. Annual urinary bladder cancer incidence counts and rates per 100,000 by sex, 1979-2001, New Jersey. Rates age-adjusted to the U.S. 2000 population standard.

Year of Diagnosis	Male		Female	
	Rate	Count	Rate	Count
1979	48.1	1,305	12.2	478
1980	48.3	1,337	12.7	509
1981	44.9	1,270	11.7	479
1982	46.1	1,320	12.4	509
1983	47.8	1,368	12.1	510
1984	44.4	1,295	11.4	486
1985	43.5	1,297	10.9	474
1986	45.2	1,362	11.7	519
1987	45.9	1,402	10.8	489
1988	50.1	1,553	11.4	512
1989	45.2	1,424	12.2	551
1990	46.8	1,477	12.2	558
1991	45.5	1,455	12.0	556
1992	48.1	1,558	12.4	576
1993	47.4	1,560	11.3	539
1994	43.1	1,432	11.4	550
1995	46.9	1,583	11.6	566
1996	43.1	1,475	11.6	573
1997	44.5	1,533	12.0	595
1998	45.2	1,590	11.5	579
1999	46.8	1,670	11.1	571
2000	45.4	1,645	12.8	656
2001*	46.3	1,654	12.4	640
1979-2001		33,565		12,475

Data are from the New Jersey State Cancer Registry, Cancer Epidemiology Services, New Jersey Department of Health and Senior Services.
* Data for 2001 are preliminary.

Table 5. Annual brain and other nervous system incidence counts and rates per 100,000 by sex, 1979-2001, New Jersey. Rates age-adjusted to the U.S. 2000 population standard.

Year of Diagnosis	Male		Female	
	Rate	Count	Rate	Count
1979	7.3	258	4.7	182
1980	7.4	249	5.0	199
1981	7.7	251	5.4	217
1982	7.9	260	6.7	275
1983	9.3	316	6.4	254
1984	8.9	305	6.2	253
1985	8.3	287	5.8	238
1986	8.4	299	5.9	245
1987	8.3	290	5.7	240
1988	8.4	293	5.8	245
1989	8.8	304	5.8	246
1990	9.2	321	6.2	260
1991	8.9	314	6.9	297
1992	8.3	298	7.3	313
1993	8.2	293	6.6	288
1994	8.9	324	6.0	267
1995	9.2	343	5.9	265
1996	8.2	311	6.2	283
1997	8.5	325	5.9	272
1998	8.7	335	6.3	288
1999	8.0	310	6.4	302
2000	8.4	327	6.0	280
2001*	7.5	290	5.2	247
1979-2001		6,903		5,956

Data are from the New Jersey State Cancer Registry, Cancer Epidemiology Services, New Jersey Department of Health and Senior Services.
* Data for 2001 are preliminary.

Table 6. Annual liver cancer incidence counts and rates per 100,000 by sex, 1979-2001, New Jersey. Rates age-adjusted to the U.S. 2000 population standard.

Year of	Male		Female	
Diagnosis	Rate	Count	Rate	Count
1979	2.9	93	1.3	49
1980	3.5	104	1.4	54
1981	3.4	105	1.3	54
1982	3.8	110	1.5	59
1983	3.9	124	1.5	61
1984	4.3	129	1.7	71
1985	3.8	123	1.7	73
1986	3.8	125	1.2	51
1987	3.9	129	1.3	60
1988	4.1	134	1.5	65
1989	4.2	141	1.6	74
1990	4.5	152	1.6	72
1991	5.1	172	1.6	74
1992	5.5	191	1.9	86
1993	5.5	187	2.3	103
1994	5.3	188	2.1	100
1995	6.2	217	2.2	107
1996	6.8	241	2.0	95
1997	6.0	219	2.3	112
1998	6.9	260	1.7	86
1999	6.2	231	2.1	104
2000	8.0	303	2.2	112
2001*	8.6	321	2.5	128
1979-2001		3,999		1,850

Data are from the New Jersey State Cancer Registry, Cancer Epidemiology Services, New Jersey Department of Health and Senior Services.
* Data for 2001 are preliminary.

Table 7. Annual mesothelioma incidence counts and rates per 100,000 by sex, 1979-2001, New Jersey. Rates age-adjusted to the U.S. 2000 population standard.

Year of	Male		Female	
Diagnosis	Rate	Count	Rate	Count
1979	1.6	50	0.5	21
1980	2.2	71	0.3	13
1981	2.7	84	0.5	19
1982	2.7	90	0.4	18
1983	2.7	90	0.6	25
1984	3.2	96	0.5	21
1985	3.1	99	0.6	27
1986	3.0	97	0.3	15
1987	3.5	109	0.6	25
1988	3.7	125	0.4	21
1989	3.2	108	0.5	21
1990	3.7	120	0.7	29
1991	2.4	83	0.2	10
1992	3.2	106	0.5	25
1993	3.1	100	0.7	32
1994	3.5	117	0.6	27
1995	3.6	125	0.3	15
1996	3.3	115	0.5	26
1997	3.1	107	0.6	32
1998	3.4	120	0.5	25
1999	2.6	91	0.7	34
2000	3.2	113	0.5	25
2001*	2.8	100	0.5	25
1979-2001		2,316		531

Data are from the New Jersey State Cancer Registry, Cancer Epidemiology Services, New Jersey Department of Health and Senior Services.
* Data for 2001 are preliminary.

Table 8. Annual lung and bronchus cancer incidence counts and rates per 100,000 by sex, 1979-2001, New Jersey. Rates age-adjusted to the U.S. 2000 population standard.

Year of Diagnosis	Male Rate	Male Count	Female Rate	Female Count
1979	112.4	3,403	36.5	1,469
1980	113.3	3,471	37.3	1,522
1981	111.0	3,415	36.1	1,511
1982	111.5	3,464	39.6	1,671
1983	110.7	3,536	40.4	1,734
1984	108.5	3,457	42.5	1,836
1985	115.4	3,691	44.3	1,914
1986	109.3	3,534	44.8	1,972
1987	108.1	3,518	46.2	2,055
1988	111.0	3,637	50.0	2,244
1989	104.0	3,425	50.1	2,259
1990	107.4	3,536	52.2	2,362
1991	105.6	3,531	52.5	2,381
1992	102.2	3,479	51.4	2,372
1993	100.2	3,424	53.2	2,459
1994	97.1	3,346	52.3	2,457
1995	95.1	3,324	53.2	2,533
1996	95.6	3,356	55.4	2,649
1997	95.3	3,394	55.4	2,689
1998	96.4	3,476	56.2	2,767
1999	87.7	3,212	55.5	2,756
2000	87.8	3,243	54.7	2,732
2001*	84.2	3,099	54.9	2,756
1979-2001		78,971		51,100

Data are from the New Jersey State Cancer Registry, Cancer Epidemiology Services, New Jersey Department of Health and Senior Services.
* Data for 2001 are preliminary.

Table 9. Annual thyroid cancer incidence counts and rates per 100,000 by sex, 1979-2001, New Jersey. Rates age-adjusted to the U.S. 2000 population standard.

Year of Diagnosis	Male Rate	Male Count	Female Rate	Female Count
1979	2.2	72	4.7	175
1980	1.7	56	4.9	188
1981	2.3	71	4.4	171
1982	2.7	86	6.0	229
1983	2.2	72	5.7	224
1984	2.9	93	6.1	240
1985	2.5	86	6.0	238
1986	3.0	100	6.4	263
1987	2.6	94	7.0	283
1988	3.2	112	6.4	264
1989	3.3	119	6.6	273
1990	2.9	104	6.8	284
1991	2.1	77	7.3	304
1992	3.1	117	7.3	305
1993	3.2	116	6.2	264
1994	3.2	120	7.2	309
1995	3.6	138	8.2	355
1996	2.9	109	8.8	379
1997	3.4	132	8.1	357
1998	3.9	153	9.3	415
1999	4.2	168	10.8	485
2000	5.2	209	14.2	641
2001*	4.4	178	14.4	647
1979-2001		2,582		7,293

Data are from the New Jersey State Cancer Registry, Cancer Epidemiology Services, New Jersey Department of Health and Senior Services.
* Data for 2001 are preliminary.

Table 10. Annual soft tissue sarcoma incidence counts and rates per 100,000 by sex, 1979-2001, New Jersey. Rates age-adjusted to the U.S. 2000 population standard.

Year of Diagnosis	Male Rate	Count	Female Rate	Count
1979	0.4	11	0.4	17
1980	0.7	18	0.4	16
1981	0.3	11	0.2	9
1982	0.6	17	0.3	11
1983	0.5	14	0.4	19
1984	0.4	12	0.4	14
1985	0.5	15	0.3	15
1986	0.4	13	0.3	13
1987	0.3	8	0.3	14
1988	0.5	16	0.4	15
1989	0.4	15	0.4	18
1990	0.4	12	0.4	16
1991	0.5	17	0.4	19
1992	0.3	10	0.6	25
1993	0.7	25	0.3	14
1994	0.7	25	0.6	29
1995	0.6	22	0.5	22
1996	0.3	12	0.7	32
1997	0.8	30	0.4	20
1998	0.6	21	0.6	30
1999	0.9	33	0.6	29
2000	0.6	22	0.5	25
2001*	0.5	17	0.4	22
1979-2001		396		444

Data are from the New Jersey State Cancer Registry, Cancer Epidemiology Services, New Jersey Department of Health and Senior Services.
* Data for 2001 are preliminary.

Table 11. Annual laryngeal cancer incidence counts and rates per 100,000 by sex, 1979-2001, New Jersey. Rates age-adjusted to the U.S. 2000 population standard.

Year of Diagnosis	Male Rate	Count	Female Rate	Count
1979	12.0	384	2.1	84
1980	12.1	398	2.2	93
1981	12.6	404	2.0	87
1982	11.3	383	2.2	95
1983	11.3	372	2.2	93
1984	11.8	395	2.4	102
1985	12.3	401	2.0	86
1986	10.9	369	2.1	90
1987	12.0	402	2.3	99
1988	10.2	350	2.3	101
1989	10.6	364	2.1	93
1990	9.6	323	2.2	98
1991	10.5	367	1.8	79
1992	10.7	375	2.4	105
1993	9.7	342	2.3	102
1994	9.1	325	2.3	103
1995	9.8	352	1.8	85
1996	9.1	328	1.9	90
1997	9.2	336	1.7	79
1998	8.6	317	2.2	104
1999	7.6	285	1.6	77
2000	8.1	310	1.6	75
2001*	8.2	313	1.6	75
1979-2001		8,195		2,095

Data are from the New Jersey State Cancer Registry, Cancer Epidemiology Services, New Jersey Department of Health and Senior Services.
* Data for 2001 are preliminary.

Table 12. Annual nasopharyngeal cancer incidence counts and rates per 100,000 by sex, 1979-2001, New Jersey. Rates age-adjusted to the U.S. 2000 population standard.

Year of Diagnosis	Male Rate	Count	Female Rate	Count
1979	1.2	39	0.5	20
1980	1.2	39	0.5	17
1981	0.9	29	0.5	20
1982	1.3	42	0.5	23
1983	1.2	37	0.5	22
1984	1.0	35	0.3	10
1985	1.4	47	0.6	27
1986	0.8	27	0.7	26
1987	1.0	34	0.4	17
1988	1.0	35	0.6	26
1989	1.1	38	0.4	19
1990	1.2	42	0.0	17
1991	1.1	37	0.4	18
1992	0.9	34	0.5	20
1993	0.9	31	0.3	16
1994	1.0	34	0.4	18
1995	1.2	44	0.5	21
1996	0.9	34	0.4	19
1997	0.9	36	0.3	13
1998	0.9	37	0.3	15
1999	1.1	43	0.4	17
2000	1.1	42	0.2	8
2001*	0.8	32	0.3	15
1979-2001		848		424

Data are from the New Jersey State Cancer Registry, Cancer Epidemiology Services, New Jersey Department of Health and Senior Services.
* Data for 2001 are preliminary.

Table 13. Annual nose, nasal cavity and middle ear cancer incidence counts and rates per 100,000 by sex, 1979-2001, New Jersey. Rates age-adjusted to the U.S. 2000 population standard.

Year of Diagnosis	Male Rate	Count	Female Rate	Count
1979	0.9	28	0.5	19
1980	0.9	28	0.6	25
1981	0.7	22	0.7	27
1982	1.0	31	0.6	22
1983	0.8	26	0.6	24
1984	1.0	32	0.6	25
1985	0.9	31	0.6	25
1986	1.0	33	0.4	18
1987	0.9	26	0.4	16
1988	1.3	46	0.8	33
1989	1.2	40	0.7	30
1990	1.4	47	0.6	26
1991	0.9	31	0.8	38
1992	1.3	40	0.4	19
1993	1.0	35	0.8	35
1994	0.9	29	0.4	20
1995	1.0	34	0.5	23
1996	1.1	40	0.8	36
1997	0.9	32	0.6	30
1998	0.8	32	0.5	26
1999	0.9	34	0.5	26
2000	1.0	37	0.4	23
2001*	1.0	39	0.5	26
1979-2001		773		592

Data are from the New Jersey State Cancer Registry, Cancer Epidemiology Services, New Jersey Department of Health and Senior Services.
* Data for 2001 are preliminary.

Table 14. Annual kidney and renal pelvis cancer incidence counts and rates per 100,000 by sex, 1979-2001, New Jersey. Rates age-adjusted to the U.S. 2000 population standard.

Year of Diagnosis	Male Rate	Count	Female Rate	Count
1979	12.3	388	5.8	231
1980	13.0	409	5.3	215
1981	12.8	396	5.6	232
1982	12.9	410	5.8	240
1983	13.0	411	6.3	261
1984	13.1	431	6.2	266
1985	14.6	465	6.8	284
1986	15.5	503	7.4	319
1987	14.3	471	7.4	325
1988	15.3	500	6.9	300
1989	16.1	544	7.5	328
1990	15.4	526	7.5	339
1991	17.2	580	7.6	347
1992	17.0	576	8.5	387
1993	17.5	610	8.6	396
1994	16.1	565	7.9	369
1995	17.9	637	9.3	433
1996	18.2	662	8.5	400
1997	17.1	618	9.4	453
1998	19.0	705	9.1	445
1999	18.4	691	9.6	472
2000	18.4	709	8.1	401
2001*	19.2	726	9.2	454
1979-2001		12,533		7,897

Data are from the New Jersey State Cancer Registry, Cancer Epidemiology Services, New Jersey Department of Health and Senior Services.
* Data for 2001 are preliminary.

Table 15. Annual osteosarcoma* incidence counts and rates per 100,000 by sex, 1979-2001, New Jersey. Rates age-adjusted to the U.S. 2000 population standard.

Year of Diagnosis	Male Rate	Count	Female Rate	Count
1979	0.3	11	0.1	6
1980	0.4	15	0.2	8
1981	0.2	9	0.2	7
1982	0.2	10	0.2	9
1983	0.6	18	0.2	8
1984	0.5	19	0.3	14
1985	0.5	19	0.3	12
1986	0.4	15	0.3	10
1987	0.4	14	0.3	12
1988	0.3	11	0.3	11
1989	0.5	16	0.1	<5
1990	0.6	19	0.3	14
1991	0.6	20	0.3	11
1992	0.6	19	0.4	14
1993	0.4	14	0.3	11
1994	0.3	11	0.2	7
1995	0.2	8	0.2	10
1996	0.4	15	0.3	11
1997	0.3	10	0.2	10
1998	0.3	13	0.4	14
1999	0.4	13	0.2	9
2000	0.2	9	0.2	11
2001**	0.4	15	0.3	13
1979-2001		323		236

Data are from the New Jersey State Cancer Registry, Cancer Epidemiology Services, New Jersey Department of Health and Senior Services.
* Osteosarcoma (C40,C41 and 9180-9185,9190 in ICD-O-2 or 9180-9187, 9192-9195 in ICD-O-3)
**Data for 2001 are preliminary.

Table 16. Annual childhood (<20 years of age) cancer: all sites combined, leukemia, and brain and other nervous system cancers (ONS) incidence, all sexes combined, counts and rates per 100,000, 1979-2001, New Jersey. Rates age-adjusted to the U.S. 2000 population standard.

Year of	All Cancers		Leukemia		Brain/ONS	
Diagnosis	Rate	Count	Rate	Count	Rate	Count
1979	17.4	399	4.6	106	2.5	57
1980	16.6	373	4.6	104	2.6	59
1981	15.1	333	4.1	91	2.4	52
1982	17.3	374	4.6	99	2.9	62
1983	19.5	415	4.6	98	3.9	82
1984	16.8	352	4.1	86	2.8	59
1985	17.6	365	4.3	88	2.6	54
1986	17.0	350	4.0	83	2.9	59
1987	16.3	333	3.8	77	3.1	63
1988	16.9	345	4.1	84	3.0	61
1989	16.4	334	4.2	86	3.0	61
1990	18.0	366	4.4	89	3.2	66
1991	17.9	367	3.9	80	3.1	64
1992	17.2	358	4.4	92	2.9	61
1993	17.6	370	4.8	101	3.1	66
1994	17.9	386	3.9	85	3.3	71
1995	16.9	370	4.3	95	3.2	70
1996	18.6	410	5.0	110	3.7	82
1997	15.8	350	4.0	88	2.6	57
1998	18.8	421	4.9	110	3.3	75
1999	17.3	391	4.4	99	3.0	67
2000	16.5	378	3.6	83	3.6	82
2001*	17.7	405	4.2	97	2.4	55
1979-2001		8,545		2,131		1,485

Data are from the New Jersey State Cancer Registry, Cancer Epidemiology Services, New Jersey Department of Health and Senior Services.
* Data for 2001 are preliminary.

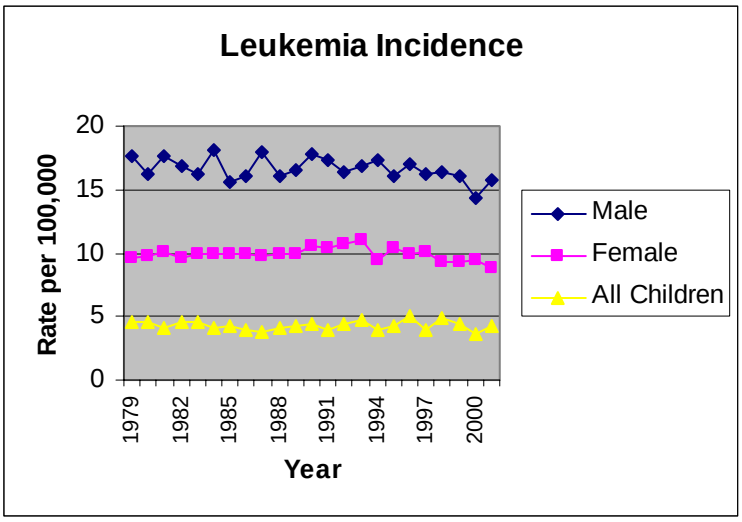
Table 17. Leukemia cases (1979-2001) lost from spatial analysis by County.

County	Cases used	Cases lost	% lost
Atlantic	462	180	28.0%
Bergen	2,364	472	16.6%
Burlington	800	183	18.6%
Camden	965	316	24.7%
Cape may	247	88	26.3%
Cumberland	255	109	29.9%
Essex	1,922	282	12.8%
Gloucester	454	148	24.6%
Hudson	1,221	314	20.5%
Hunterdon	179	114	38.9%
Mercer	818	152	15.7%
Middlesex	1,566	298	16.0%
Monmouth	1,224	329	21.2%
Morris	1,027	208	16.8%
Ocean	1,371	453	24.8%
Passaic	1,218	182	13.0%
Salem	108	91	45.7%
Somerset	523	150	22.3%
Sussex	190	95	33.3%
Union	1,265	225	15.1%
Warren	204	119	36.8%
Unknown		37	
Total	**18,383**	**4,545**	**19.8%**

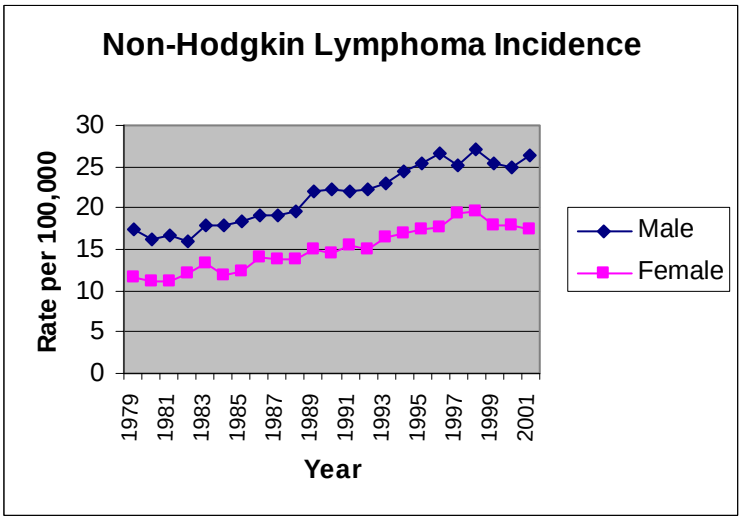
Table 18. Leukemia cases (1979-2001) lost from spatial analysis by County and Time Period

	Time Period					
	1979-1990			1991-2001		
County	Cases lost	Cases used	% lost	Cases lost	Cases used	% lost
Atlantic	115	212	35.2%	65	250	20.6%
Bergen	314	1,146	21.5%	158	1,218	11.5%
Burlington	124	324	27.7%	59	476	11.0%
Camden	227	400	36.2%	89	565	13.6%
Cape may	54	80	40.3%	34	167	16.9%
Cumberland	71	122	36.8%	38	133	22.2%
Essex	189	935	16.8%	93	987	8.6%
Gloucester	91	183	33.2%	57	271	17.4%
Hudson	240	546	30.5%	74	675	9.9%
Hunterdon	77	53	59.2%	37	126	22.7%
Mercer	104	383	21.4%	48	435	9.9%
Middlesex	188	684	21.6%	110	882	11.1%
Monmouth	231	519	30.8%	98	705	12.2%
Morris	134	458	22.6%	74	569	11.5%
Ocean	300	484	38.3%	153	887	14.7%
Passaic	114	574	16.6%	68	644	9.6%
Salem	62	33	65.3%	29	75	27.9%
Somerset	89	216	29.2%	61	307	16.6%
Sussex	61	70	46.6%	34	120	22.1%
Union	158	634	19.9%	67	631	9.6%
Warren	74	86	46.3%	45	118	27.6%
Unknown	21			16		
Total	**3,038**	**8,142**	**27.2%**	**1,507**	**10,241**	**12.8%**

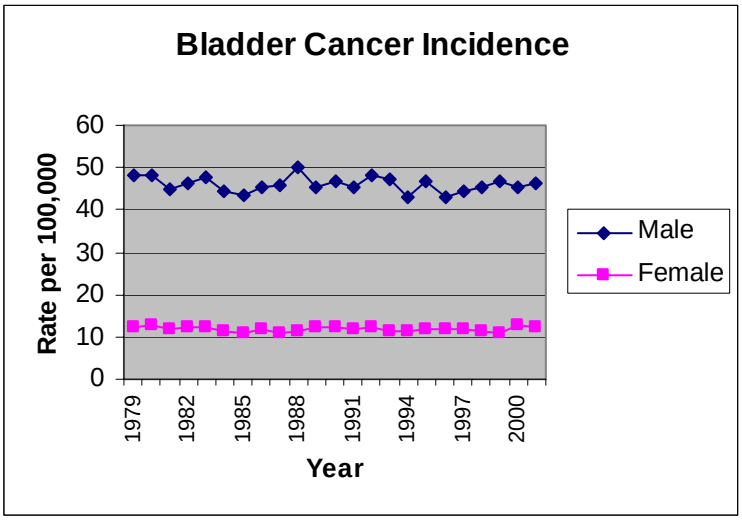
Graph 1. Trends in leukemia incidence in New Jersey.



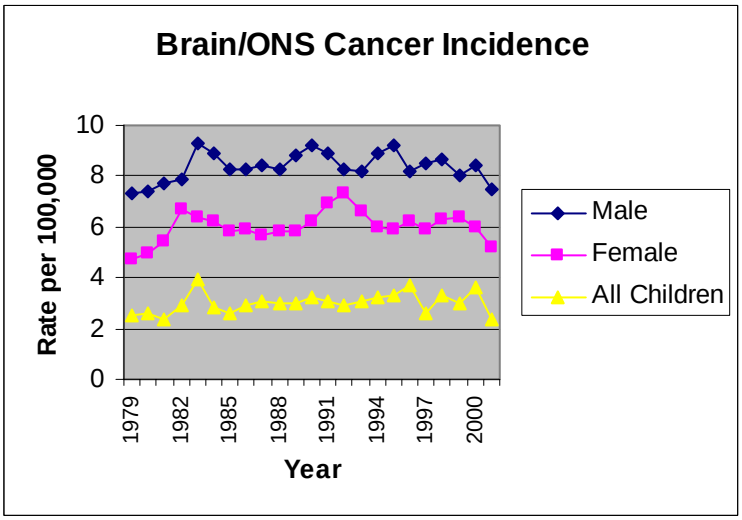
Graph 2. Trends in non-Hodgkin lymphoma incidence in New Jersey.



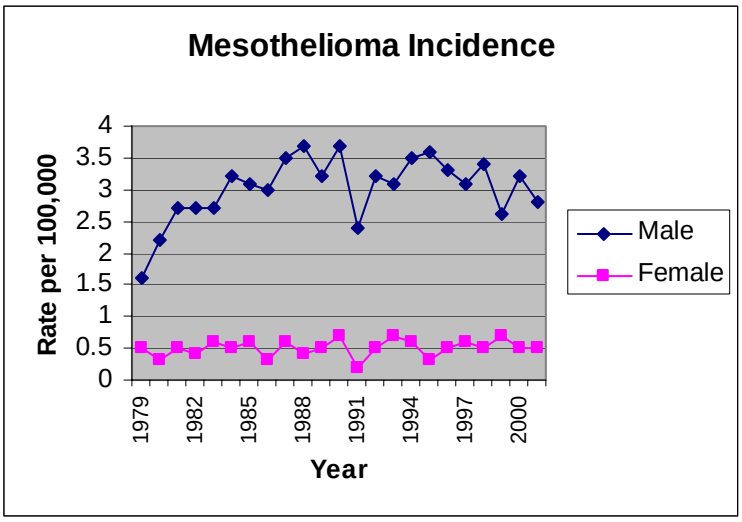
Graph 3. Trends in urinary bladder cancer incidence in New Jersey.



Graph 4. Trends in brain and other nervous system cancer incidence in New Jersey.



Graph 5. Trends in mesothelioma incidence in New Jersey.



Graph 6. Trends in thyroid cancer incidence in New Jersey.

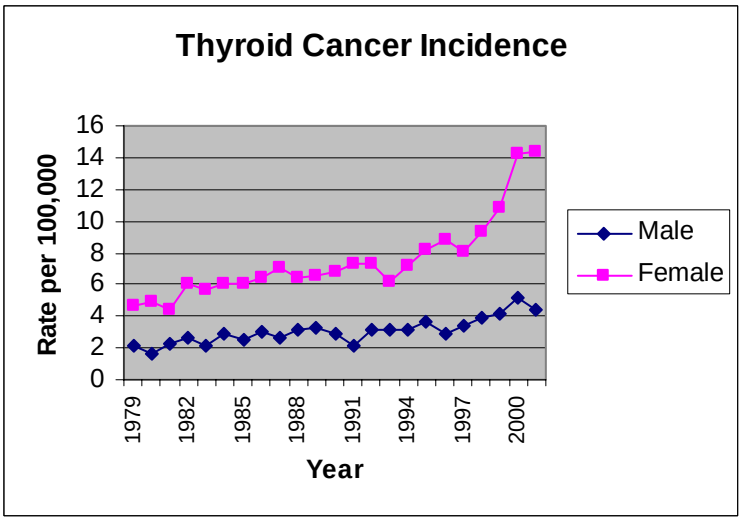
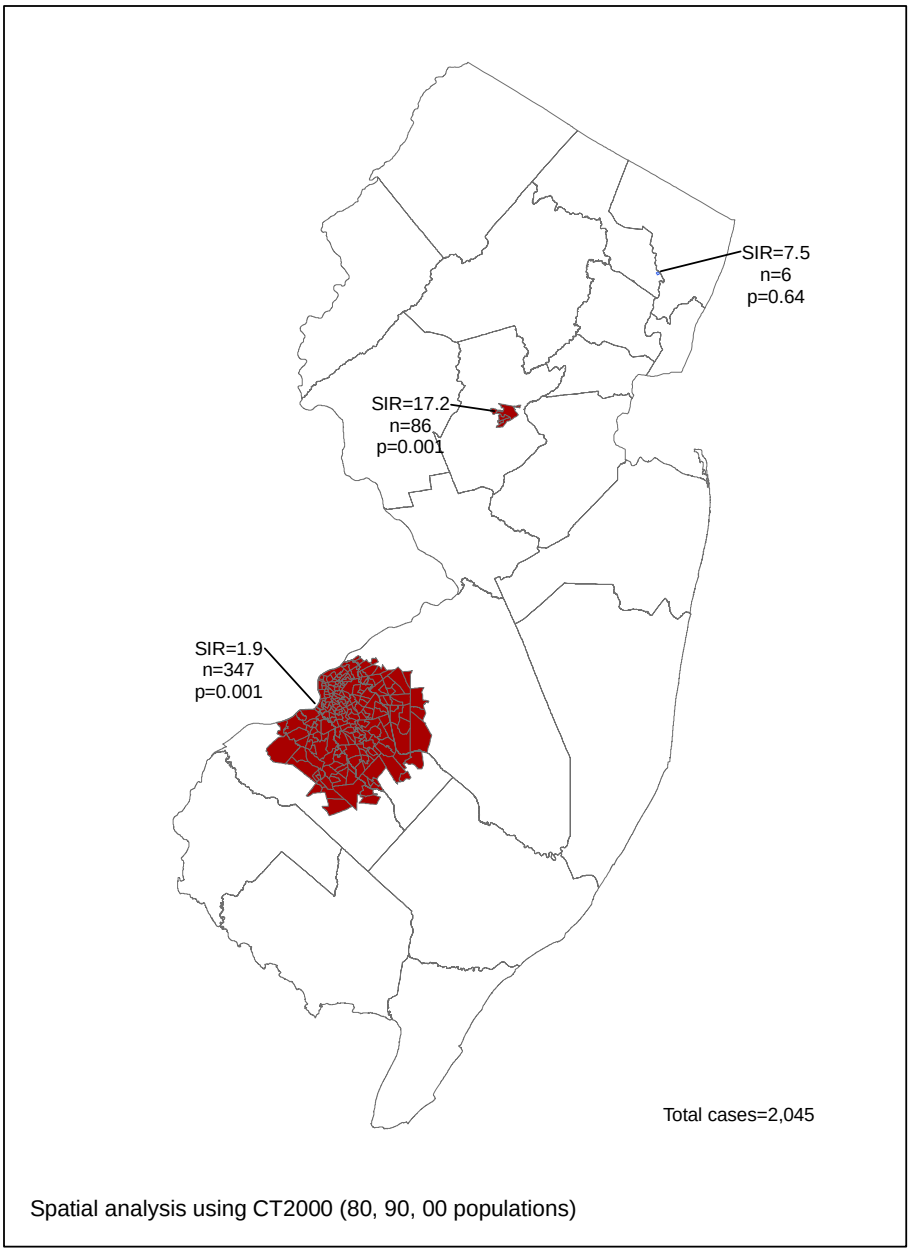
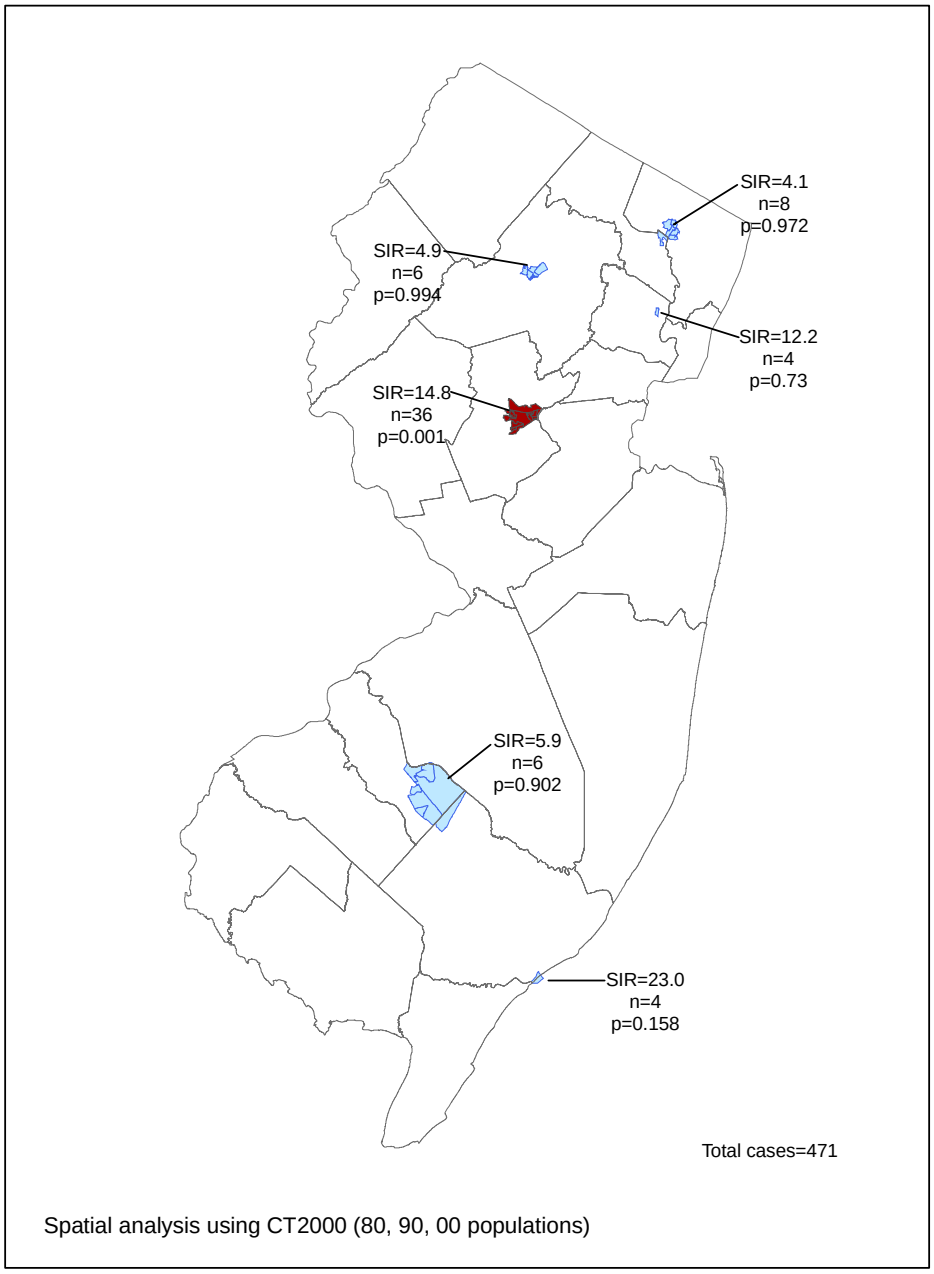


Figure 1. Male Mesothelioma, 1979-2001



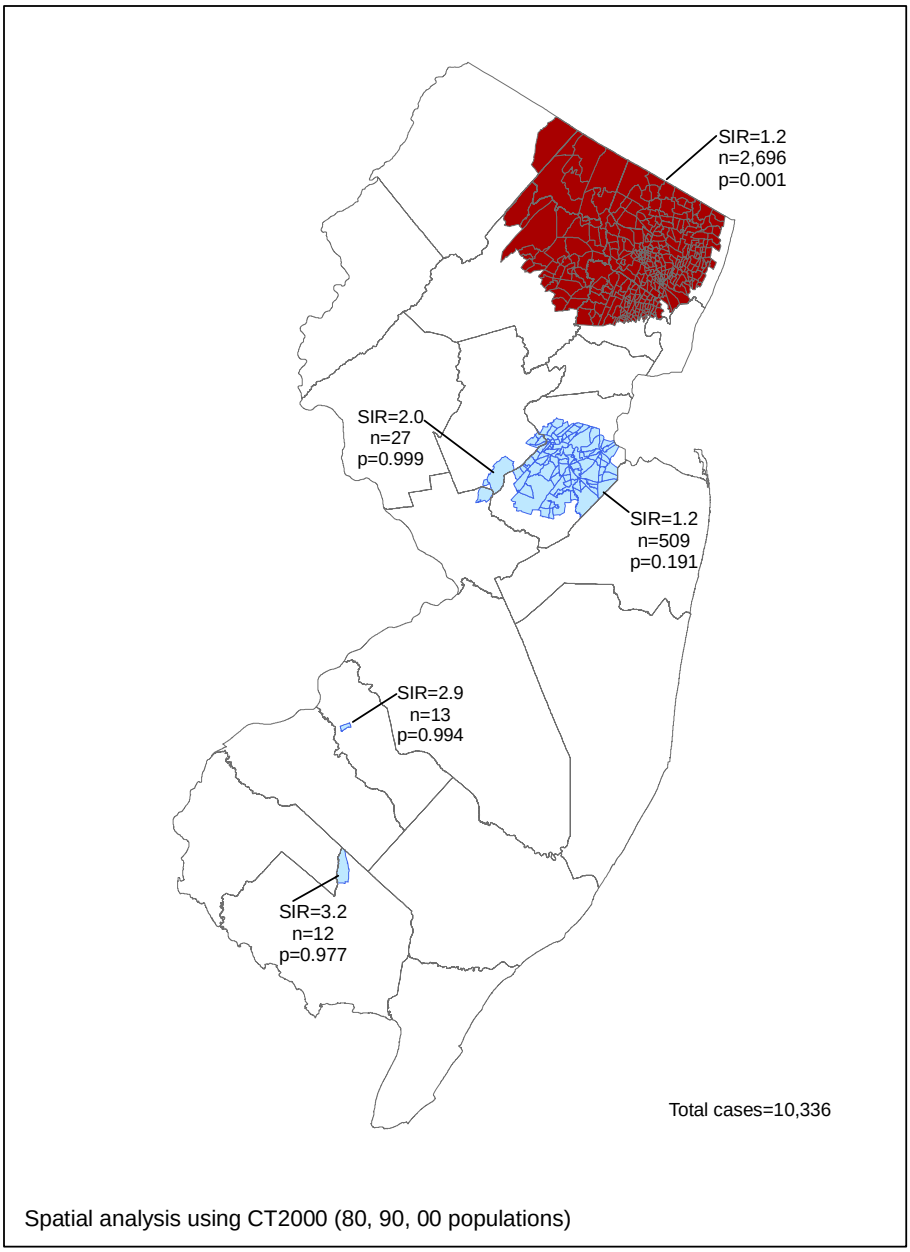
This map was generated as part of the CDC-funded Environmental and Health Effects Tracking demonstration project. This cluster analysis should be considered to be exploratory only, as results are dependent on the software parameters used, data completeness, and geocoding success rates.

Figure 2. Female Mesothelioma, 1979-2001



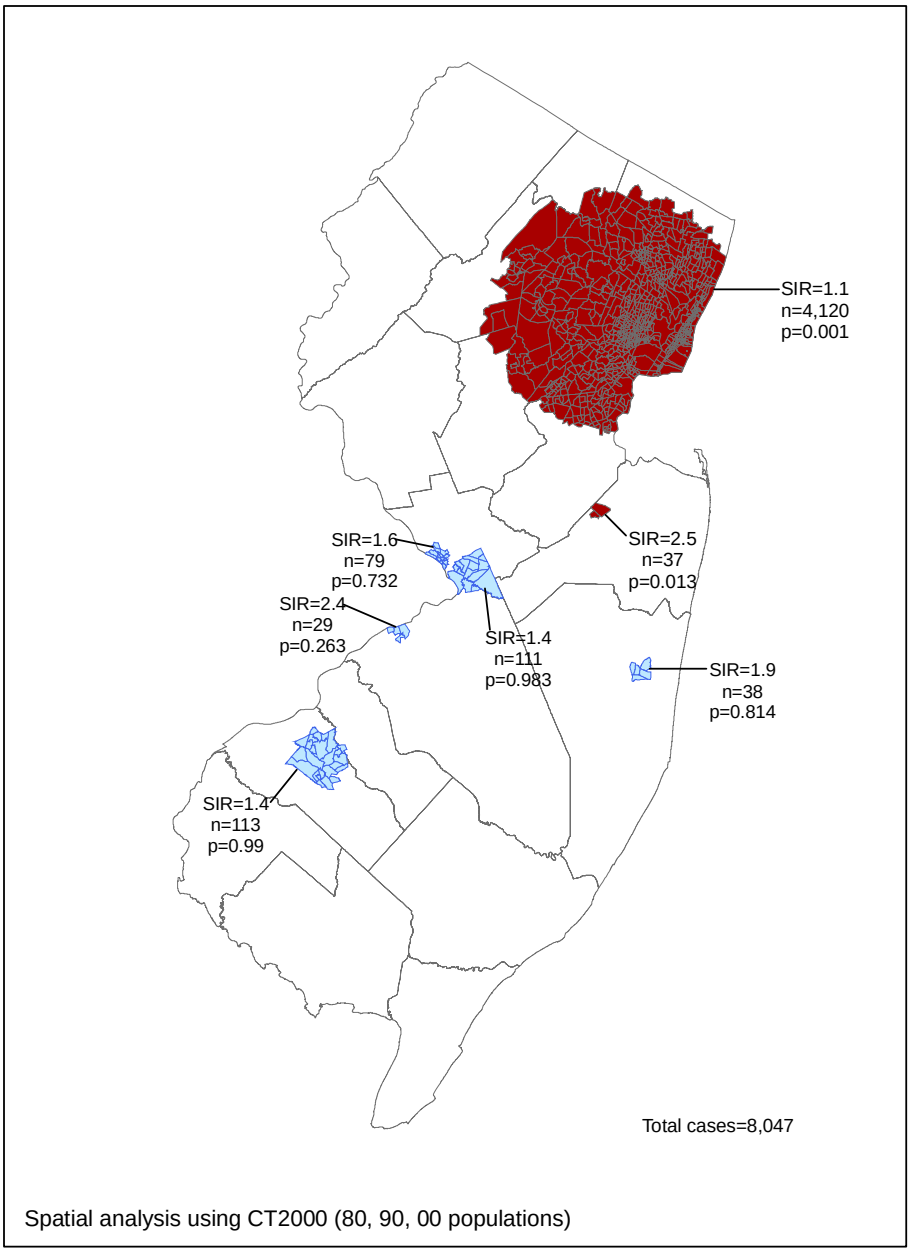
This map was generated as part of the CDC-funded Environmental and Health Effects Tracking demonstration project. This cluster analysis should be considered to be exploratory only, as results are dependent on the software parameters used, data completeness, and geocoding success rates.

Figure 3. Male Leukemia, 1979-2001



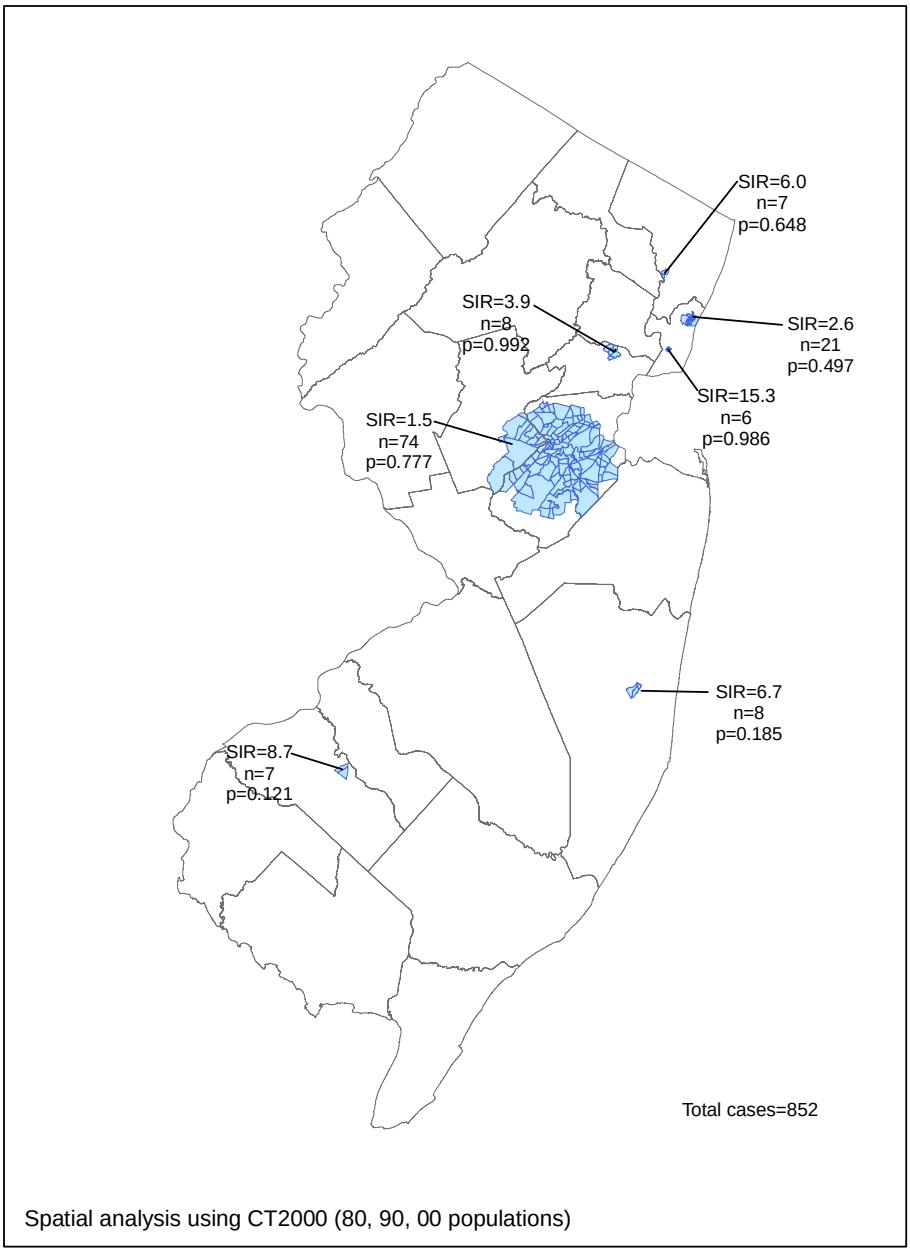
This map was generated as part of the CDC-funded Environmental and Health Effects Tracking demonstration project. This cluster analysis should be considered to be exploratory only, as results are dependent on the software parameters used, data completeness, and geocoding success rates.

Figure 4. Female Leukemia, 1979-2001



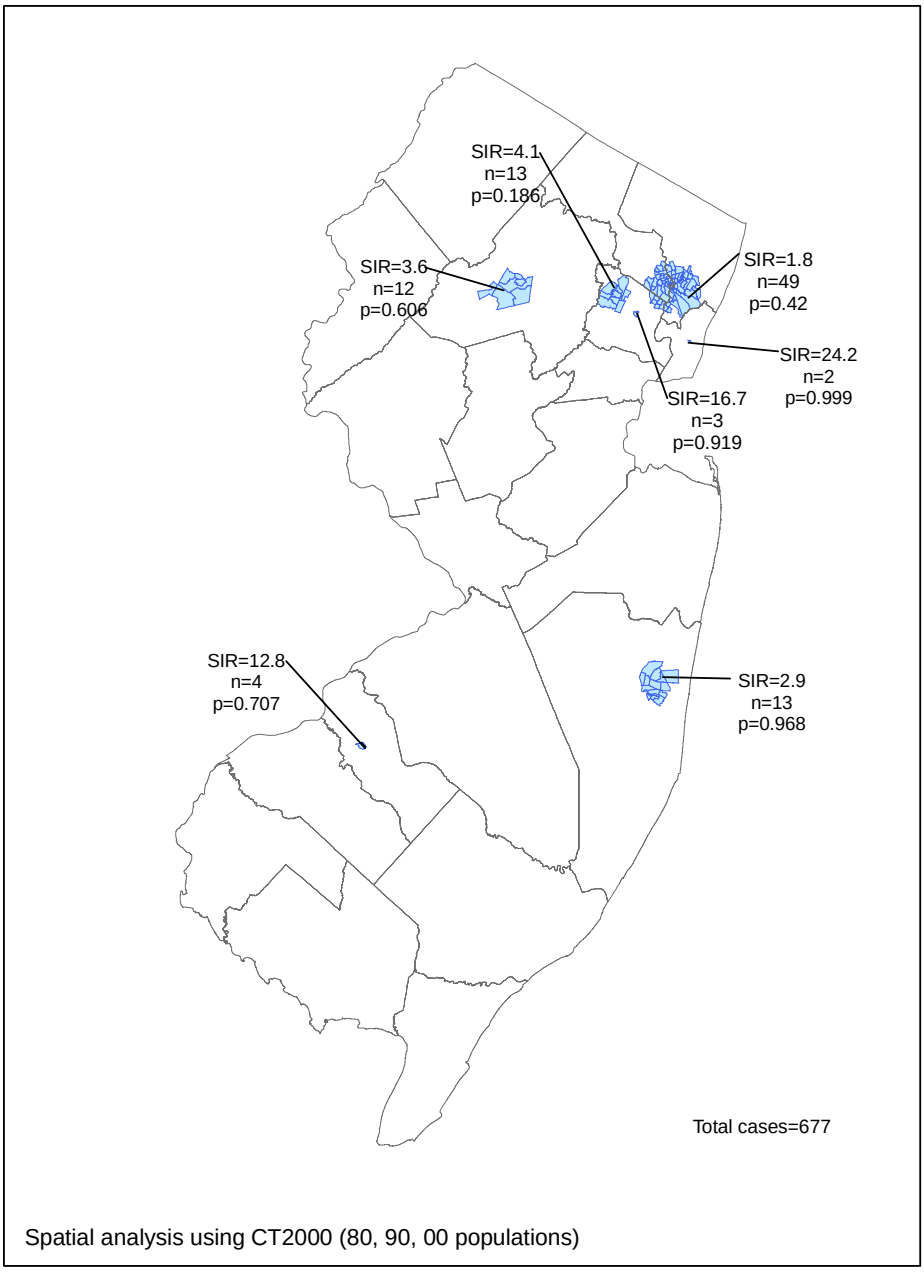
This map was generated as part of the CDC-funded Environmental and Health Effects Tracking demonstration project. This cluster analysis should be considered to be exploratory only, as results are dependent on the software parameters used, data completeness, and geocoding success rates.

Figure 5. Male Childhood Leukemia, 1979-2001



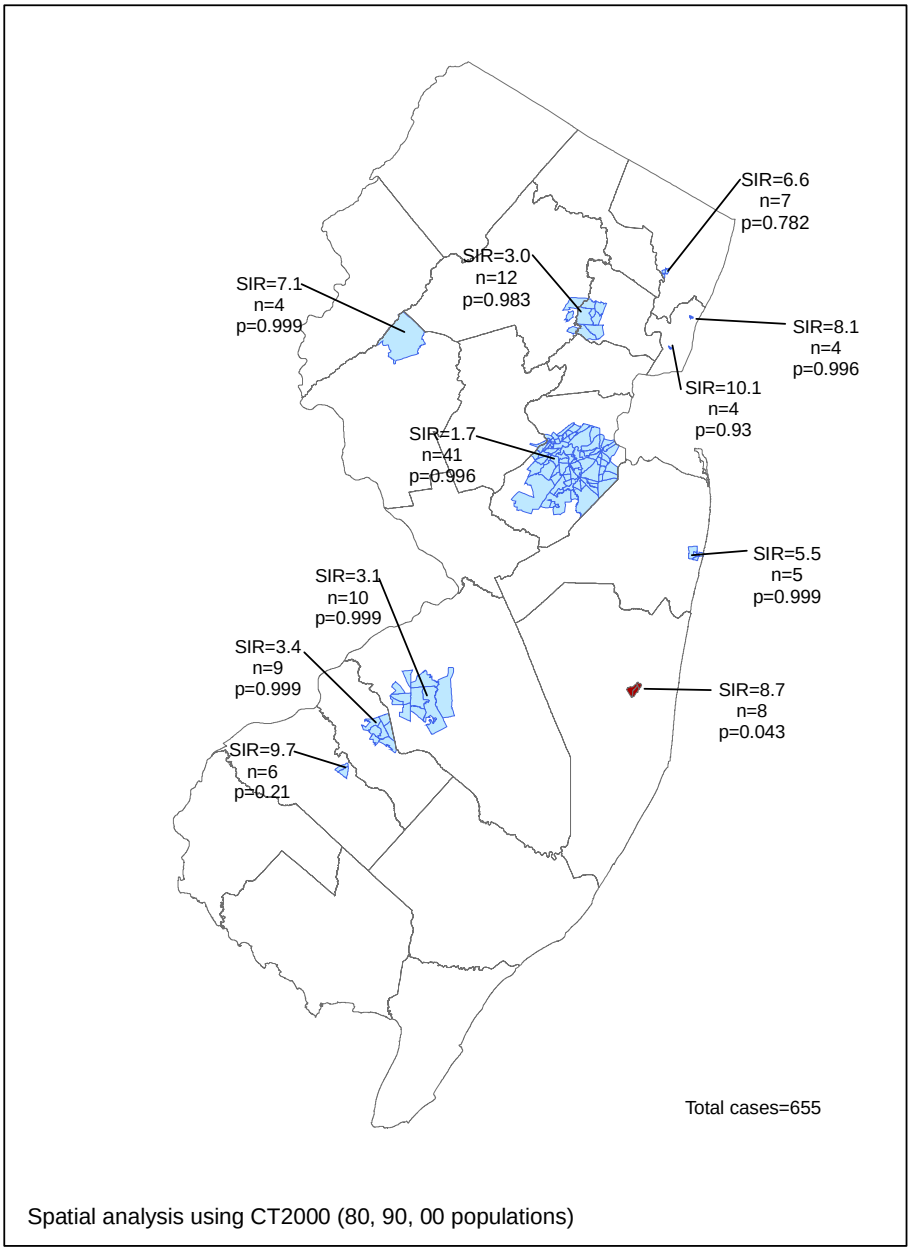
This map was generated as part of the CDC-funded Environmental and Health Effects Tracking demonstration project. This cluster analysis should be considered to be exploratory only, as results are dependent on the software parameters used, data completeness, and geocoding success rates.

Figure 6. Female Childhood Leukemia, 1979-2001



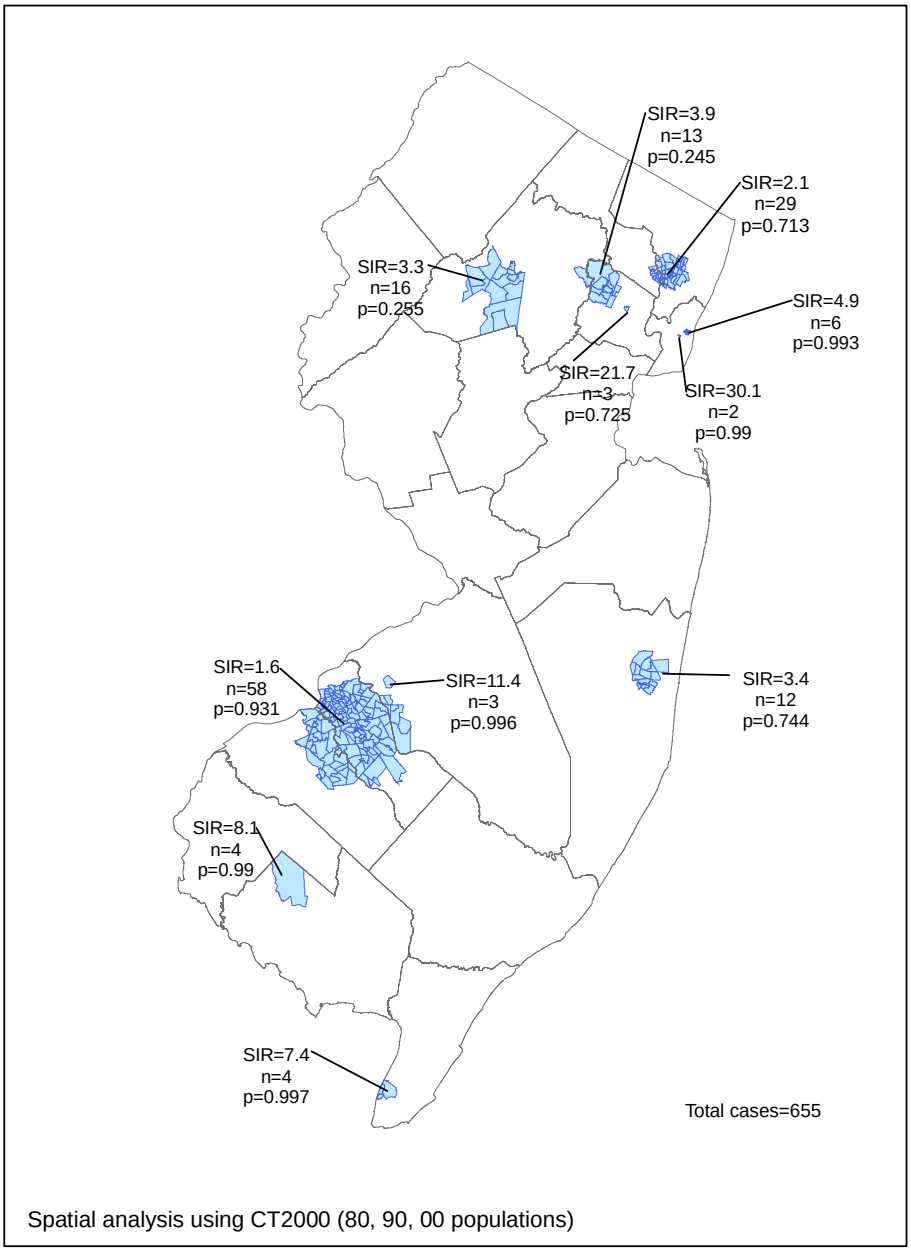
This map was generated as part of the CDC-funded Environmental and Health Effects Tracking demonstration project. This cluster analysis should be considered to be exploratory only, as results are dependent on the software parameters used, data completeness, and geocoding success rates.

Figure 7. Male Childhood Acute Lymphocyic Leukemia, 1979-2001



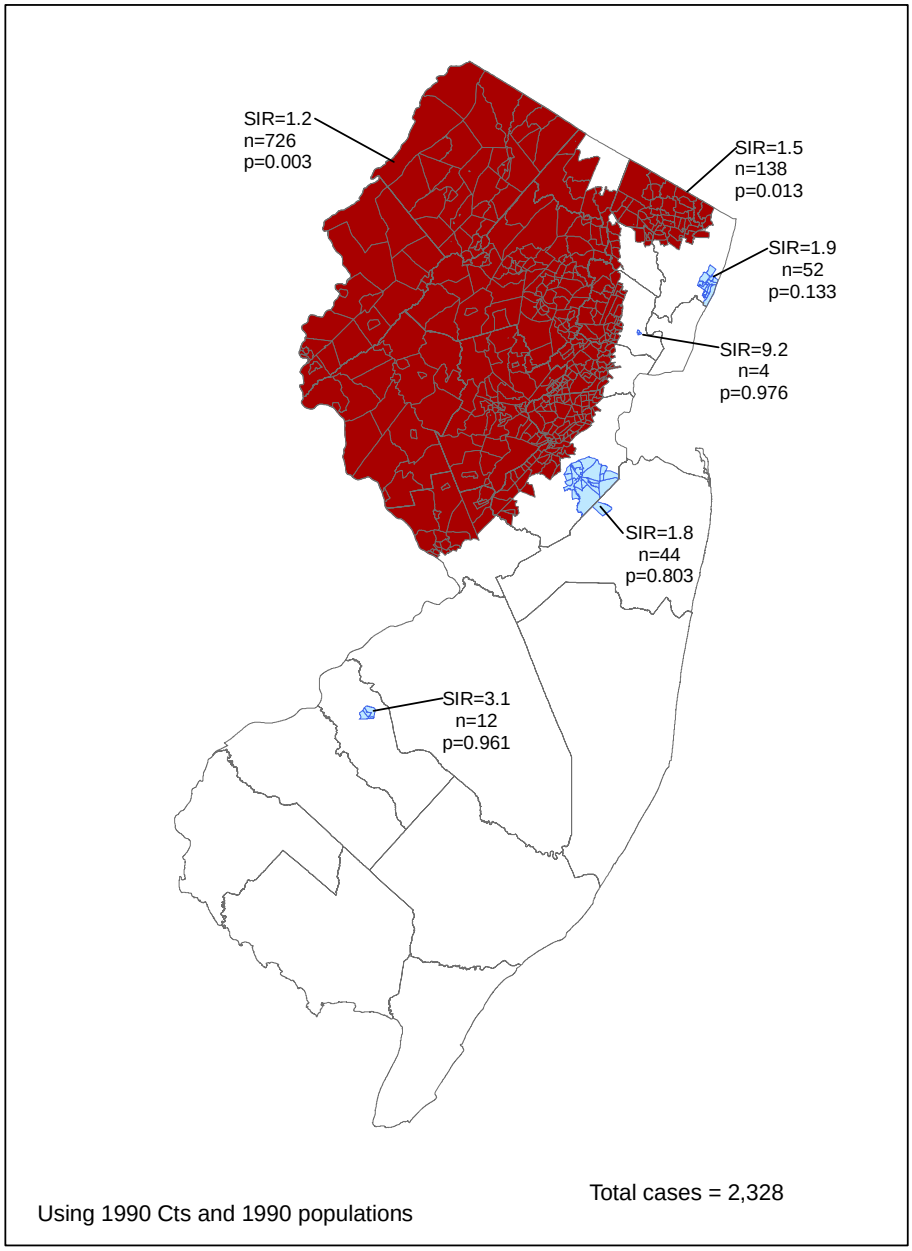
This map was generated as part of the CDC-funded Environmental and Health Effects Tracking demonstration project. This cluster analysis should be considered to be exploratory only, as results are dependent on the software parameters used, data completeness, and geocoding success rates.

Figure 8. Female Childhood Acute Lymphocyic Leukemia, 1979-2001



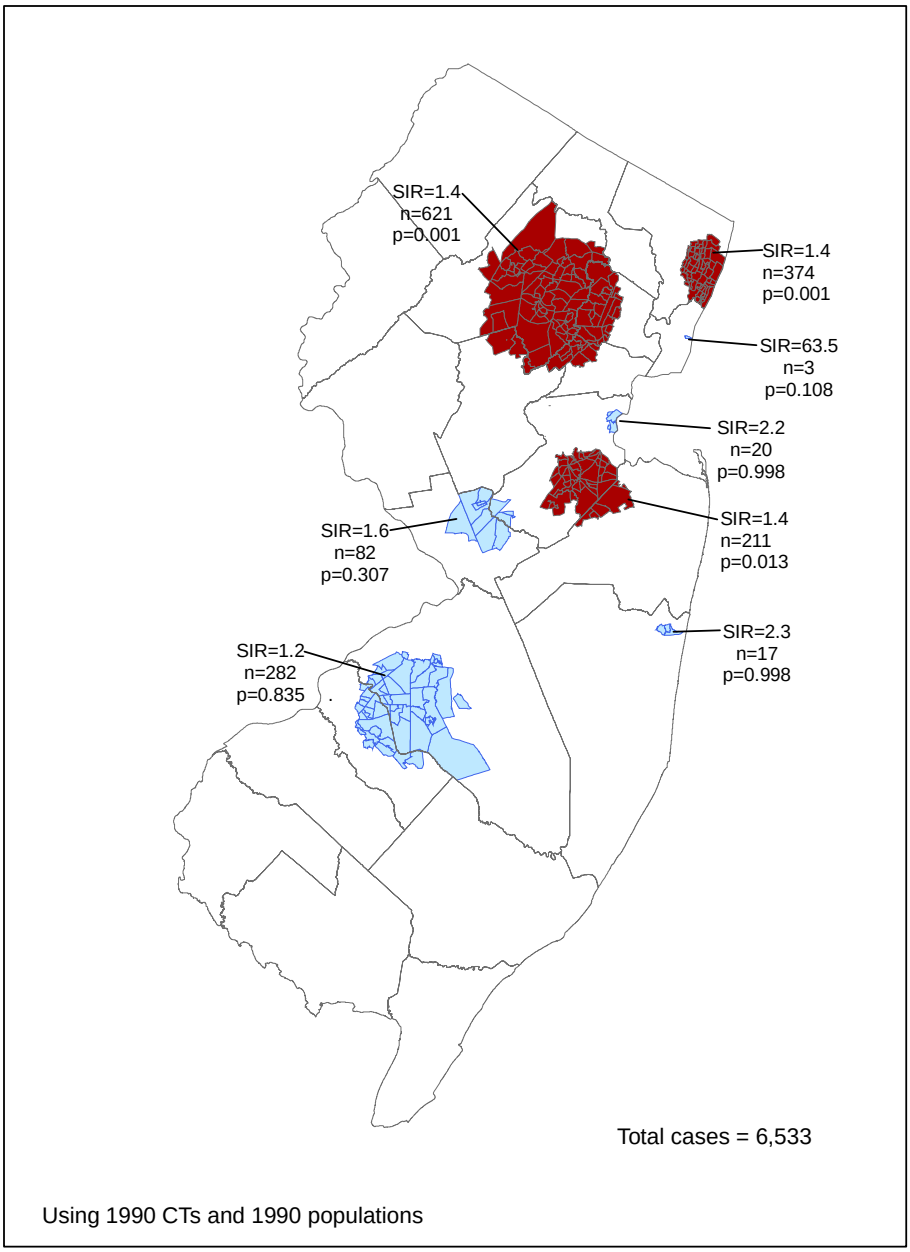
This map was generated as part of the CDC-funded Environmental and Health Effects Tracking demonstration project. This cluster analysis should be considered to be exploratory only, as results are dependent on the software parameters used, data completeness, and geocoding success rates.

Figure 9. Male Thyroid Cancer, 1979-2001



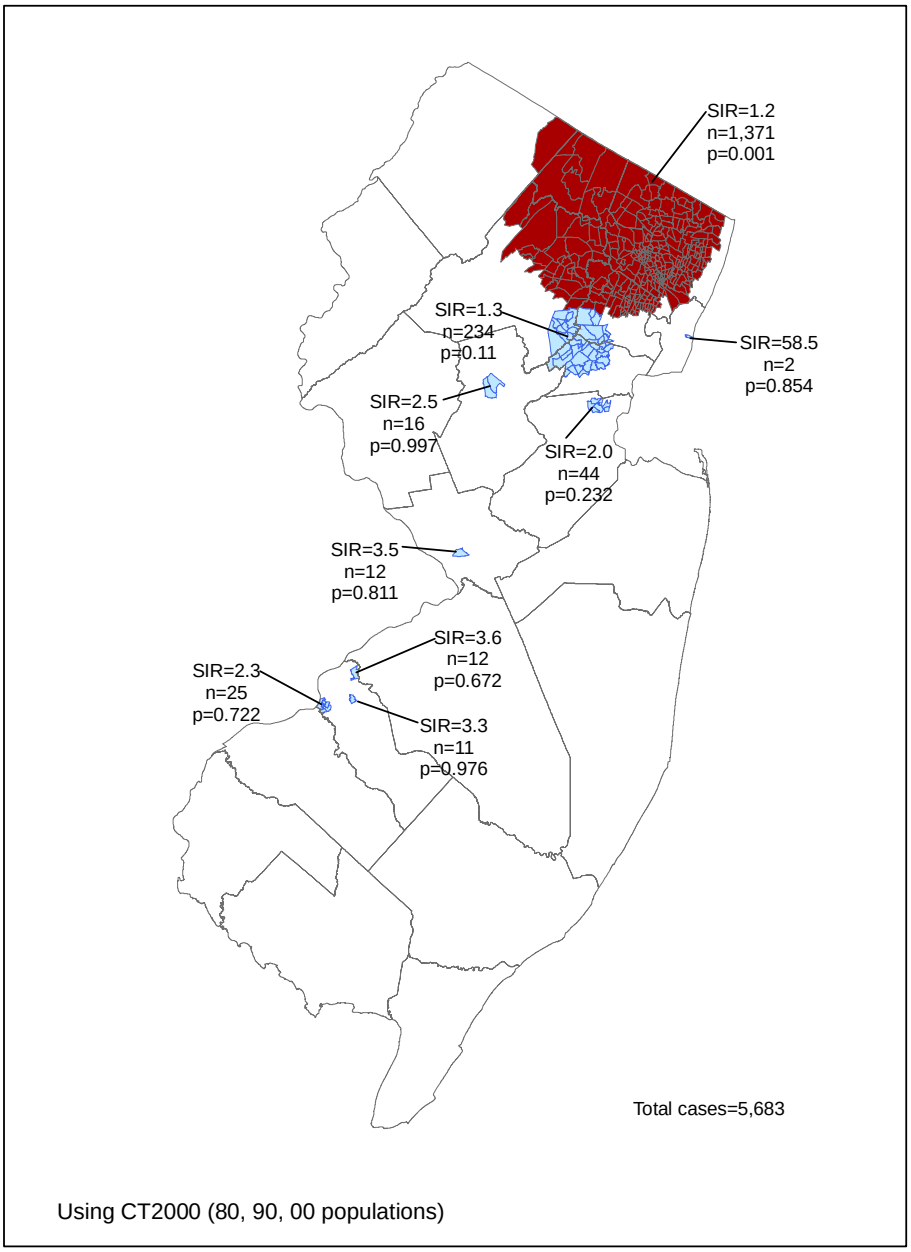
This map was generated as part of the CDC-funded Environmental and Health Effects Tracking demonstration project. This cluster analysis should be considered to be exploratory only, as results are dependent on the software parameters used, data completeness, and geocoding success rates.

Figure 10. Female Thyroid Cancer, 1979-2001



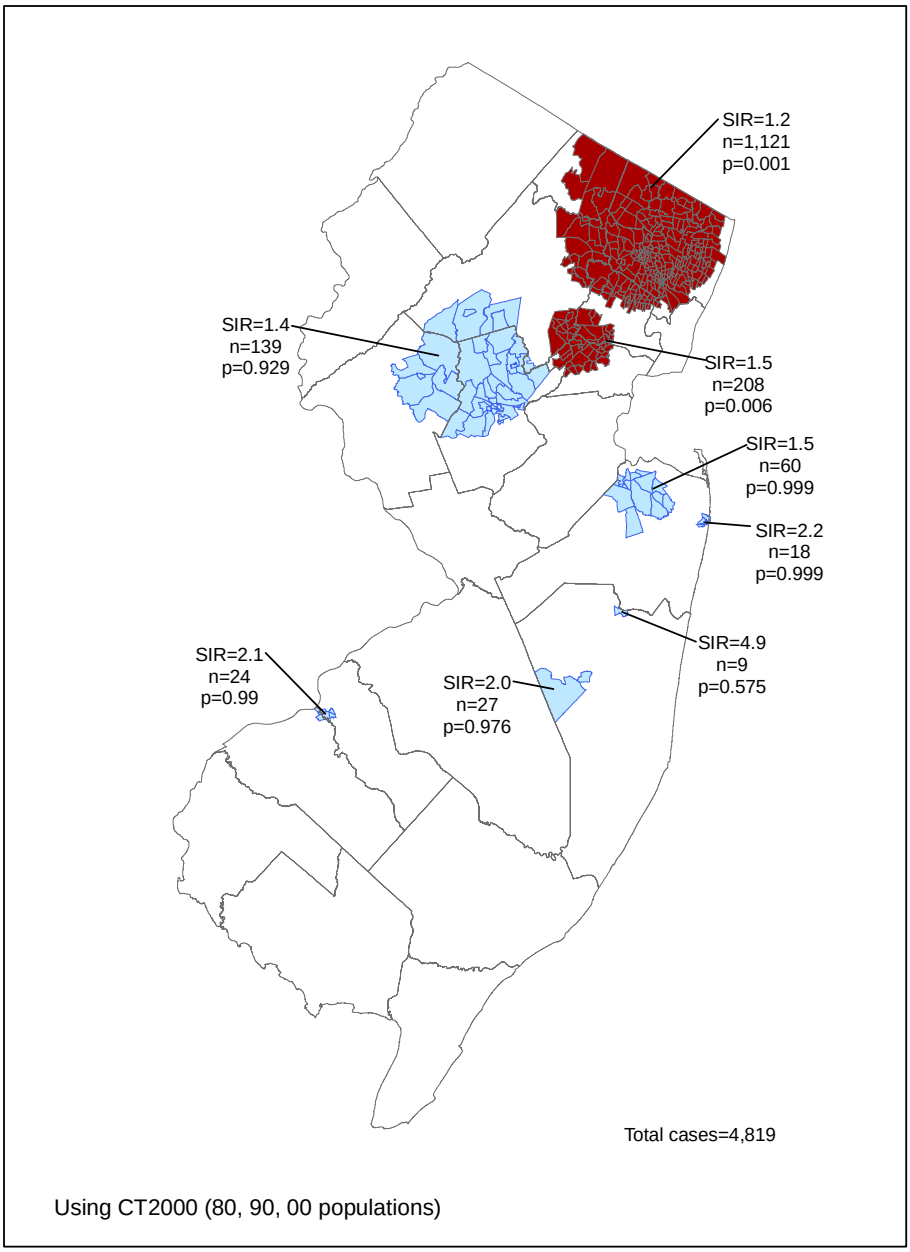
This map was generated as part of the CDC-funded Environmental and Health Effects Tracking demonstration project. This cluster analysis should be considered to be exploratory only, as results are dependent on the software parameters used, data completeness, and geocoding success rates.

Figure 11. Male Brain/ONC Cancer, 1979-2001



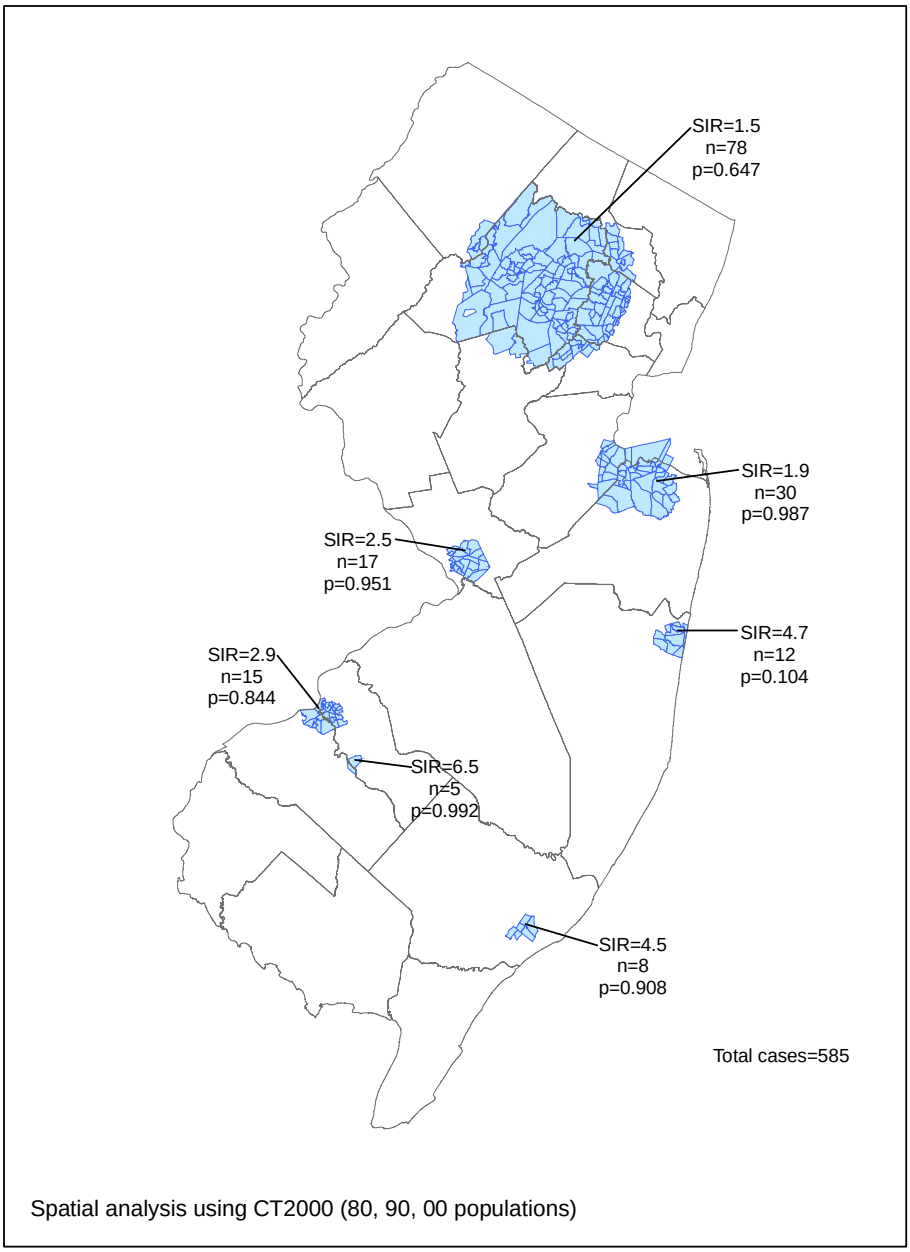
This map was generated as part of the CDC-funded Environmental and Health Effects Tracking demonstration project. This cluster analysis should be considered to be exploratory only, as results are dependent on the software parameters used, data completeness, and geocoding success rates.

Figure 12. Female Brain/ONS Cancer, 1979-2001



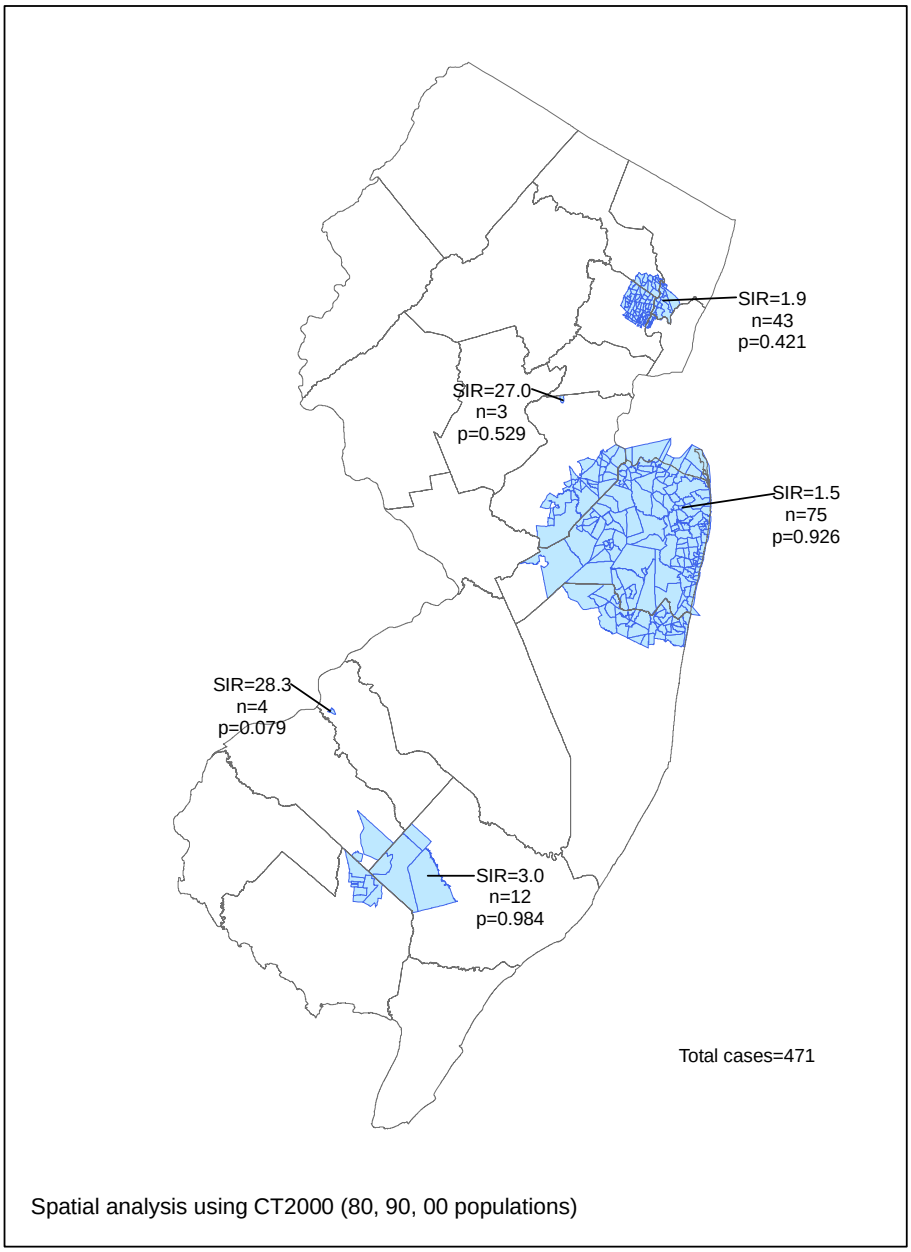
This map was generated as part of the CDC-funded Environmental and Health Effects Tracking demonstration project. This cluster analysis should be considered to be exploratory only, as results are dependent on the software parameters used, data completeness, and geocoding success rates.

Figure 13. Male Childhood Brain/ONS Cancer, 1979-2001



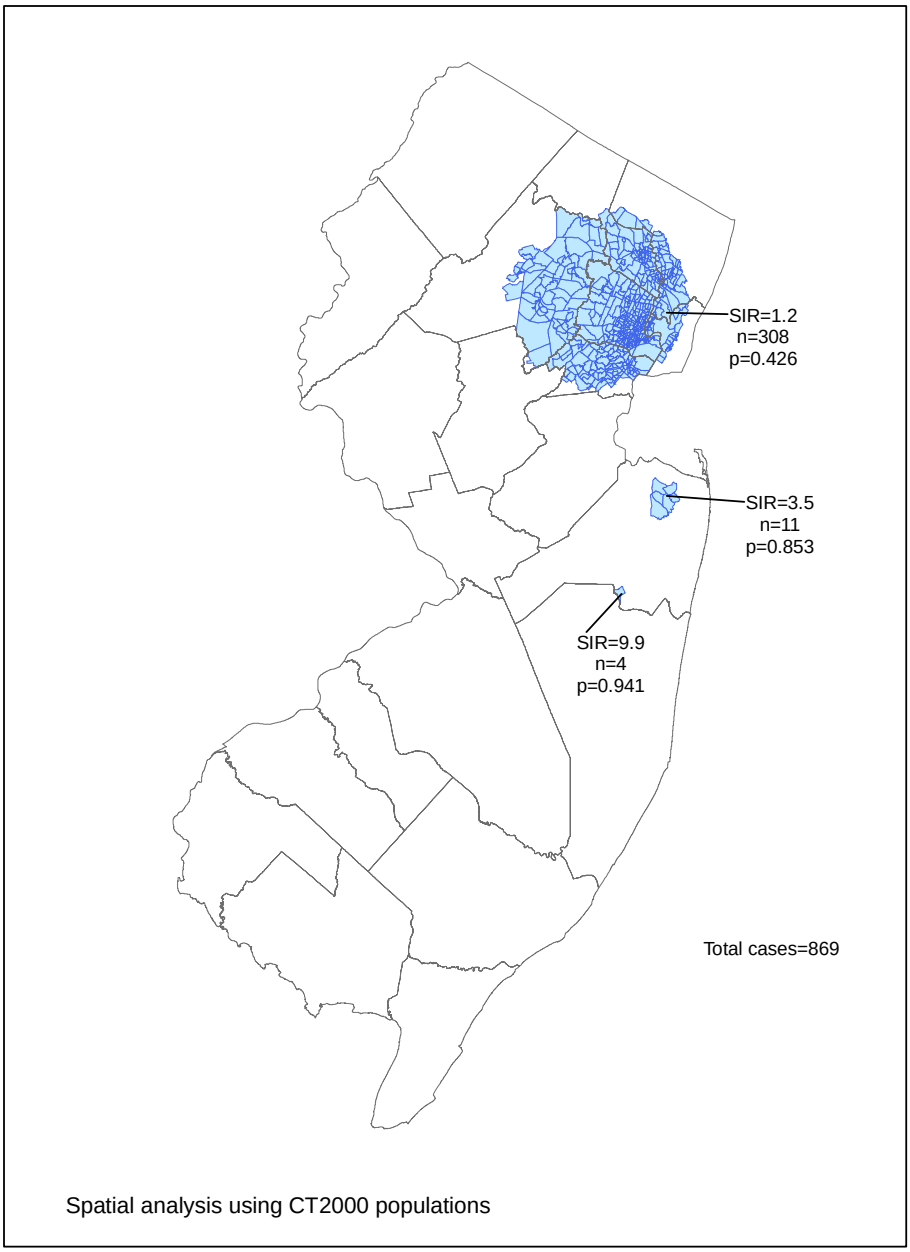
This map was generated as part of the CDC-funded Environmental and Health Effects Tracking demonstration project. This cluster analysis should be considered to be exploratory only, as results are dependent on the software parameters used, data completeness, and geocoding success rates.

Figure 14. Female Childhood Brain/ONS Cancer, 1979-2001



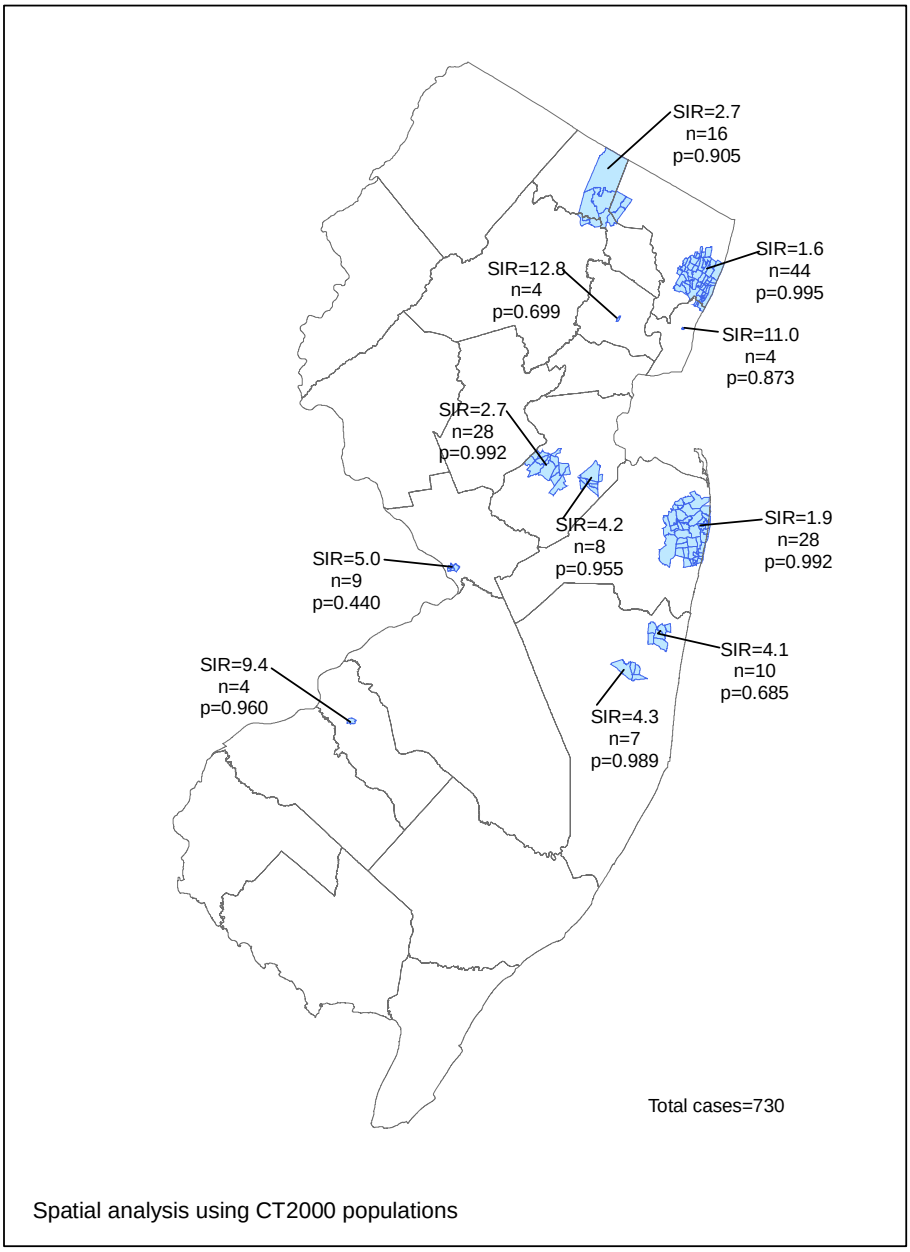
This map was generated as part of the CDC-funded Environmental and Health Effects Tracking demonstration project. This cluster analysis should be considered to be exploratory only, as results are dependent on the software parameters used, data completeness, and geocoding success rates.

Figure 15. Male Bone Cancer, 1979-2001



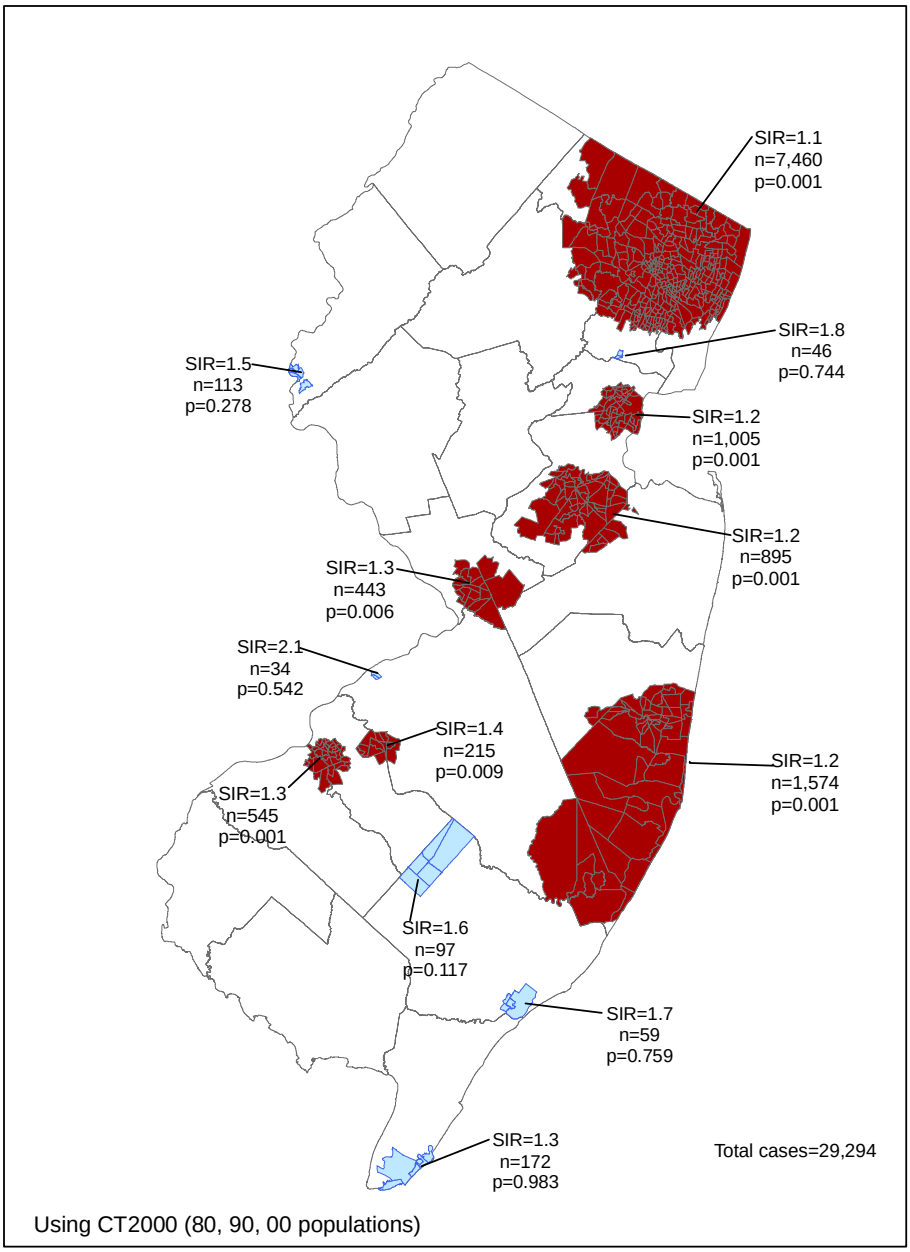
This map was generated as part of the CDC-funded Environmental and Health Effects Tracking demonstration project. This cluster analysis should be considered to be exploratory only, as results are dependent on the software parameters used, data completeness, and geocoding success rates.

Figures 16. Female Bone Cancer, 1979-2001



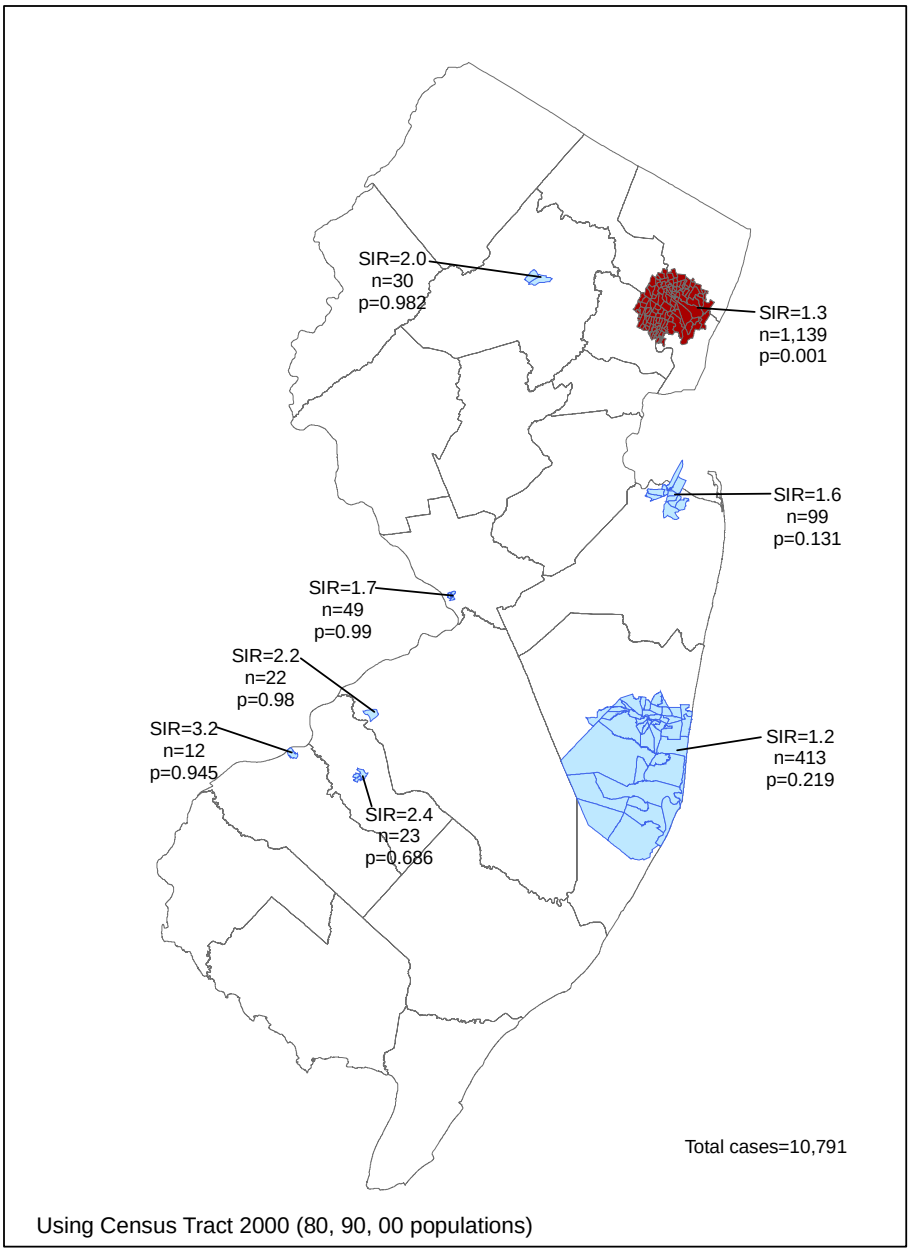
This map was generated as part of the CDC-funded Environmental and Health Effects Tracking demonstration project. This cluster analysis should be considered to be exploratory only, as results are dependent on the software parameters used, data completeness, and geocoding success rates.

Figure 17. Male Bladder Cancer, 1979-2001



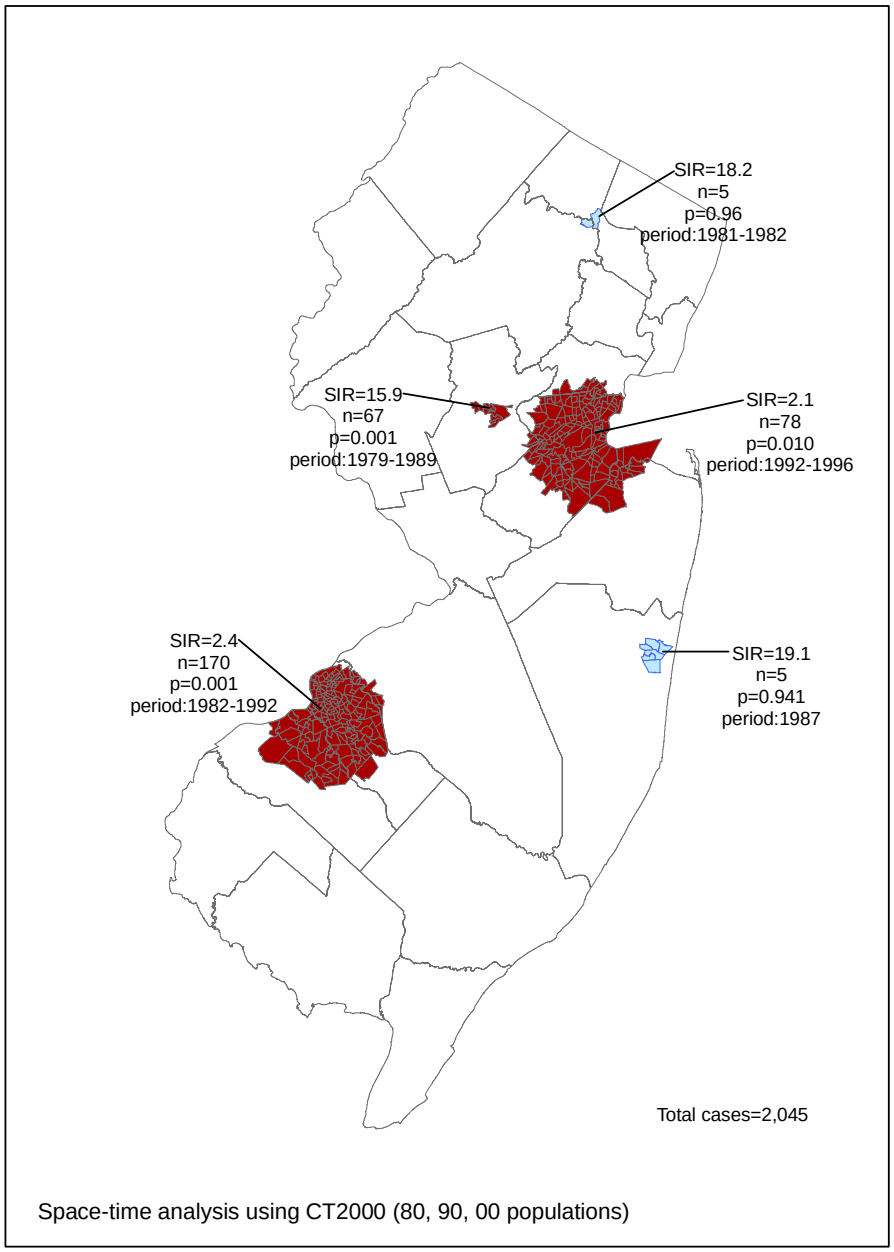
This map was generated as part of the CDC-funded Environmental and Health Effects Tracking demonstration project. This cluster analysis should be considered to be exploratory only, as results are dependent on the software parameters used, data completeness, and geocoding success rates.

Figure 18. Female Bladder Cancer, 1979-2001



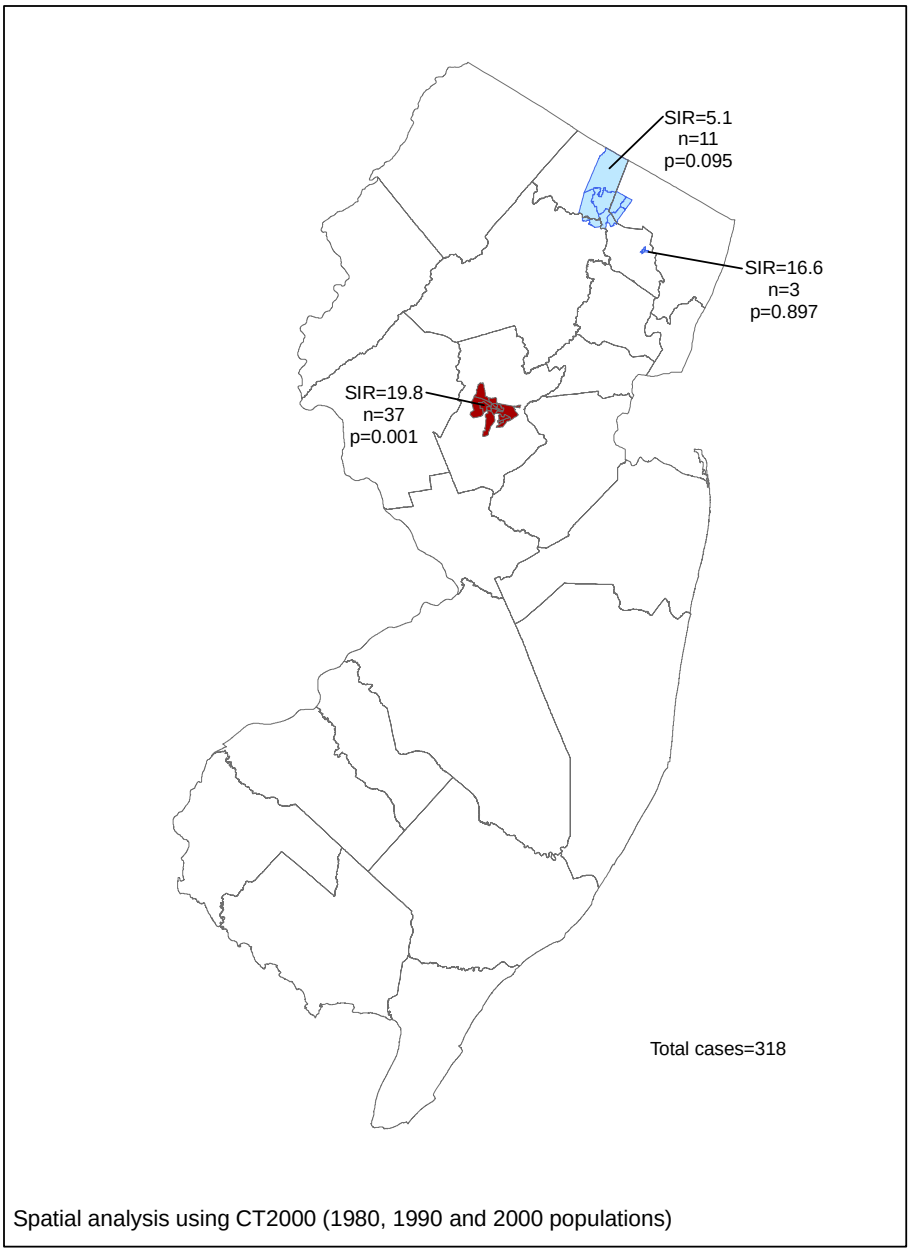
This map was generated as part of the CDC-funded Environmental and Health Effects Tracking demonstration project. This cluster analysis should be considered to be exploratory only, as results are dependent on the software parameters used, data completeness, and geocoding success rates.

Figure 19. Male Mesothelioma, 1979-2001



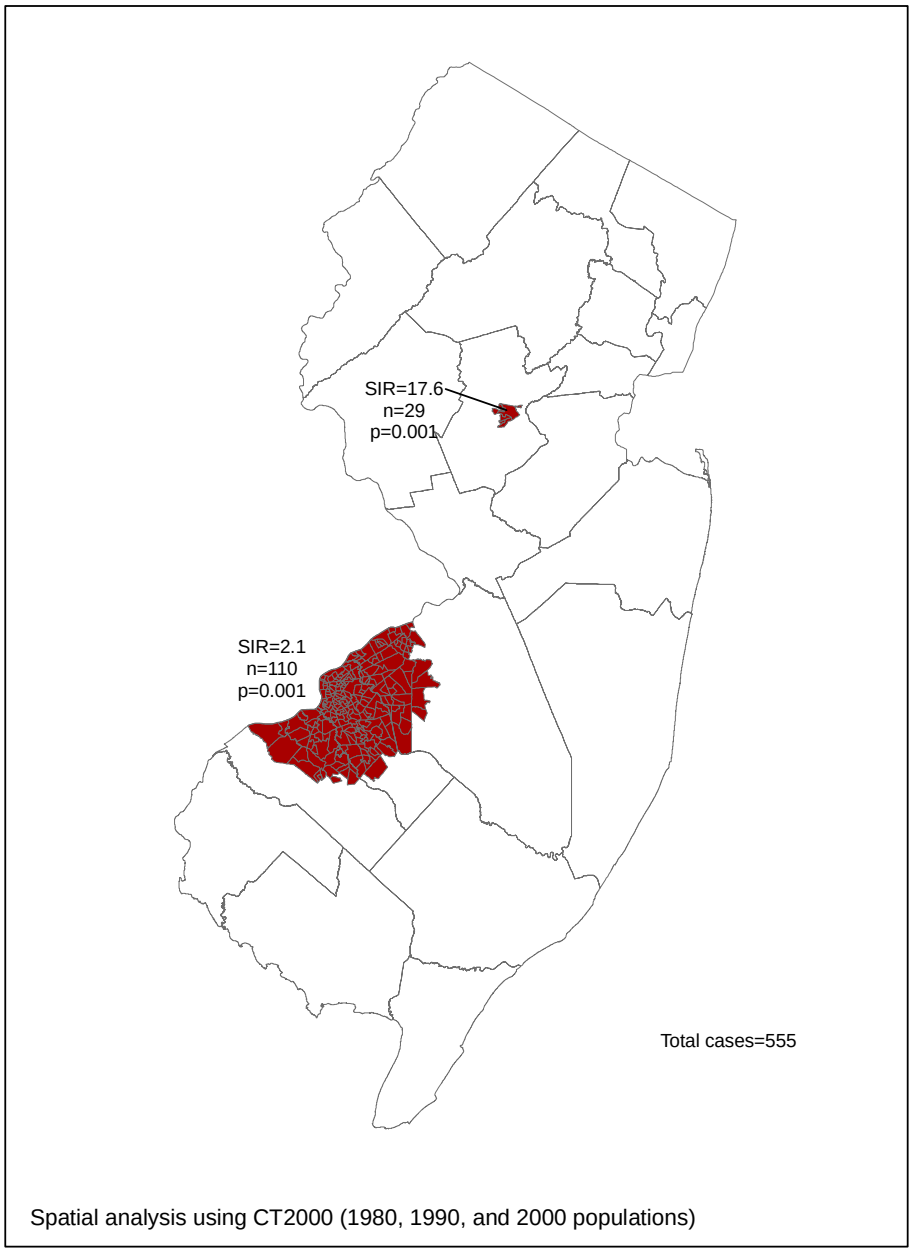
This map was generated as part of the CDC-funded Environmental and Health Effects Tracking demonstration project. This cluster analysis should be considered to be exploratory only, as results are dependent on the software parameters used, data completeness, and geocoding success rates.

Figure 20. Male Mesothelioma, 1979-1983



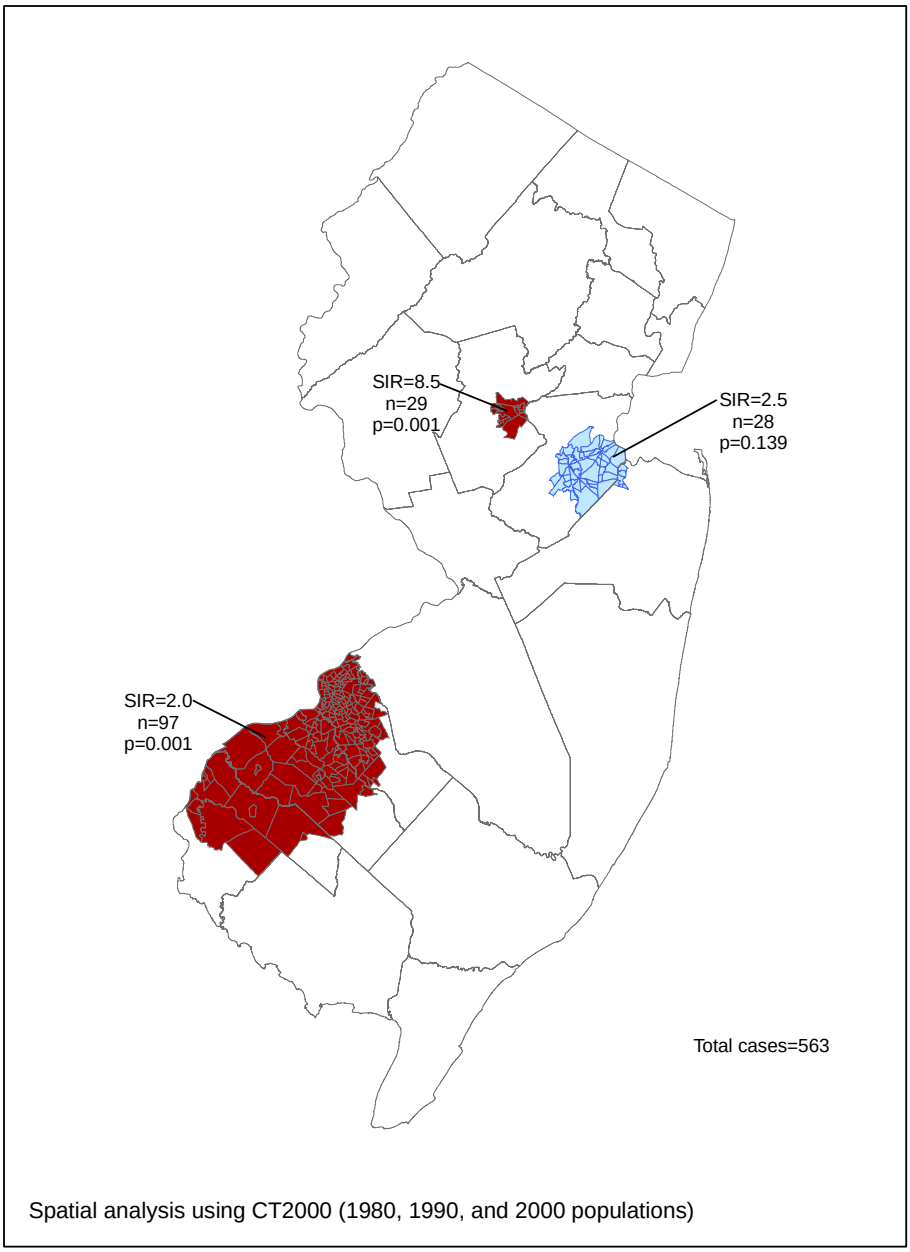
This map was generated as part of the CDC-funded Environmental and Health Effects Tracking demonstration project. This cluster analysis should be considered to be exploratory only, as results are dependent on the software parameters used, data completeness, and geocoding success rates.

Figure 21. Male Mesothelioma, 1984-1989



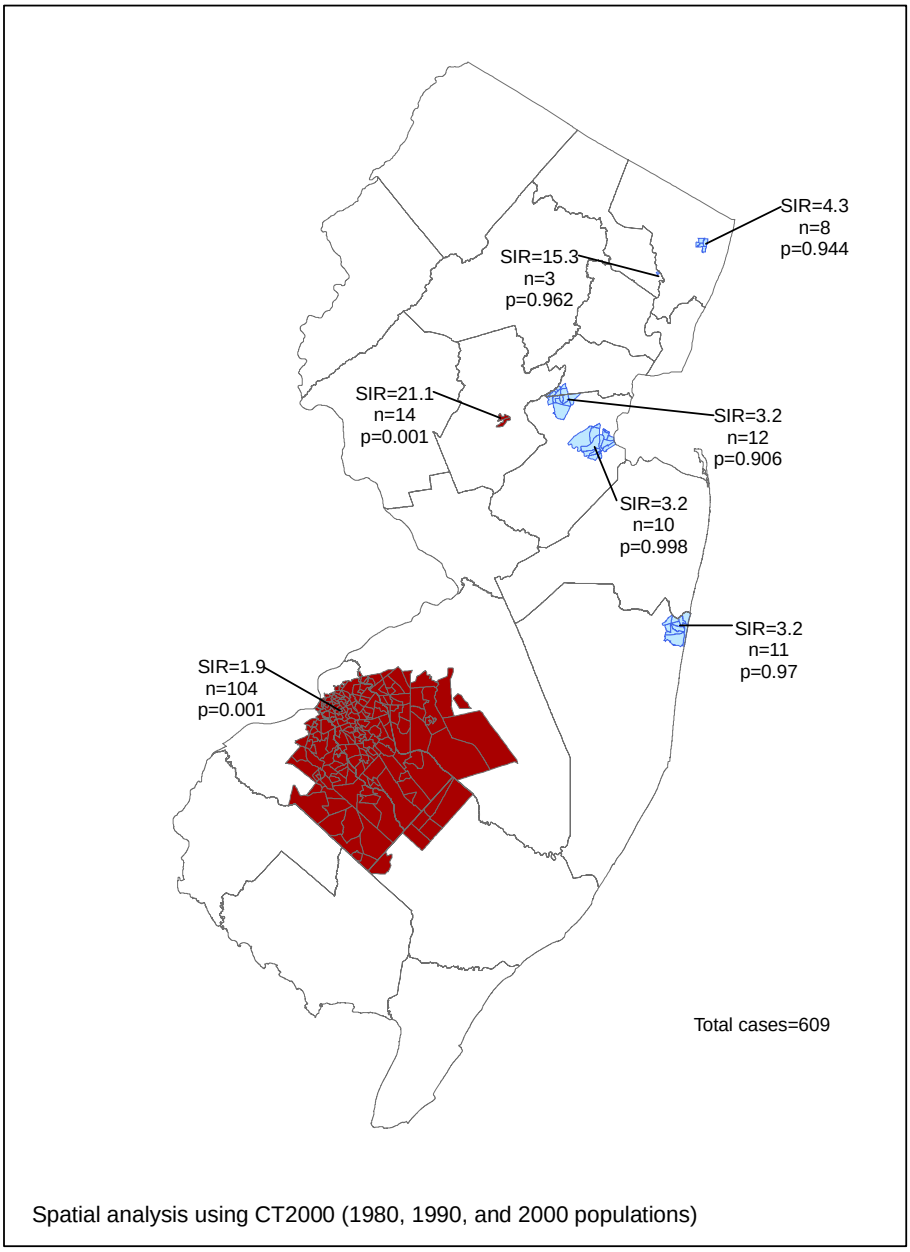
This map was generated as part of the CDC-funded Environmental and Health Effects Tracking demonstration project. This cluster analysis should be considered to be exploratory only, as results are dependent on the software parameters used, data completeness, and geocoding success rates.

Figure 22. Male Mesothelioma, 1990-1995



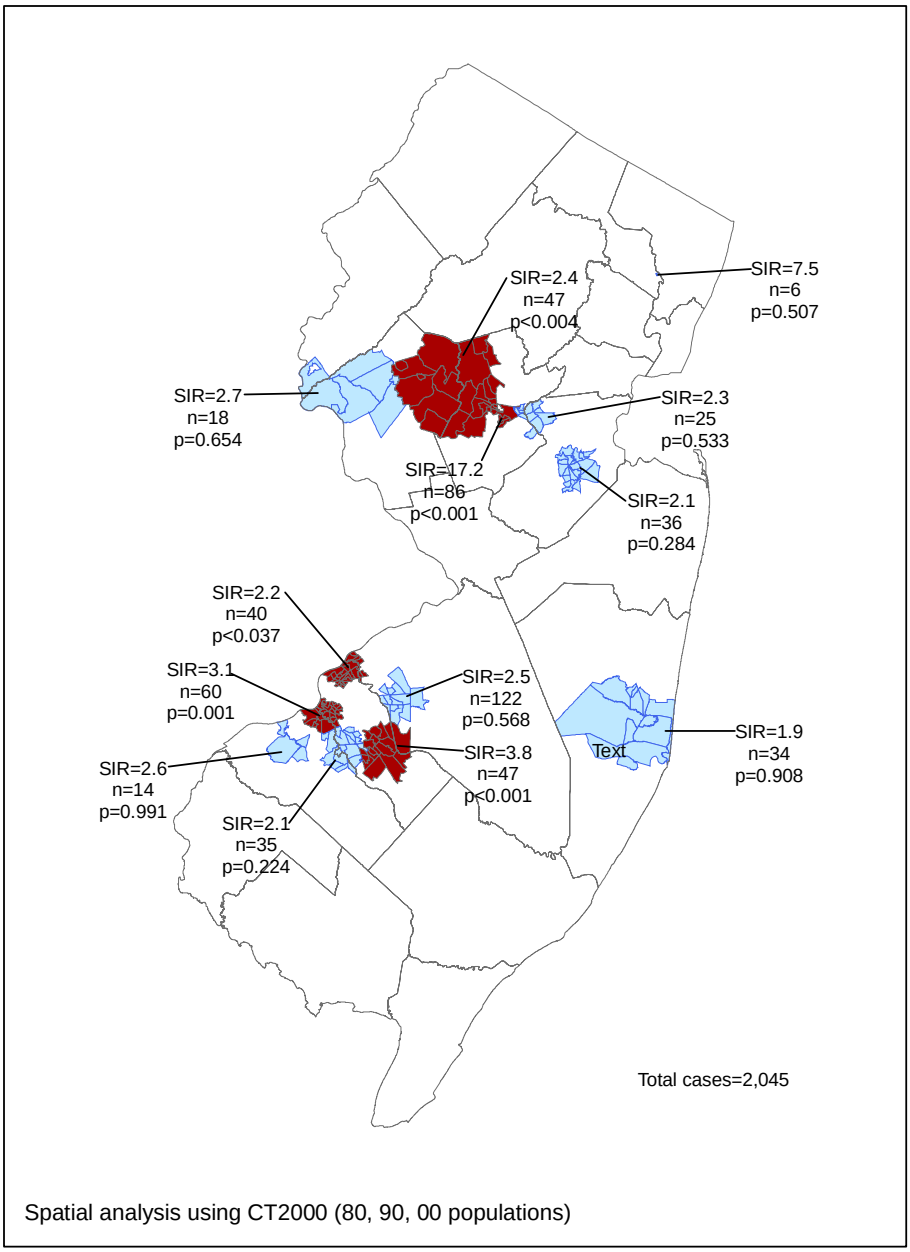
This map was generated as part of the CDC-funded Environmental and Health Effects Tracking demonstration project. This cluster analysis should be considered to be exploratory only, as results are dependent on the software parameters used, data completeness, and geocoding success rates.

Figure 23. Male Mesothelioma, 1996-2001



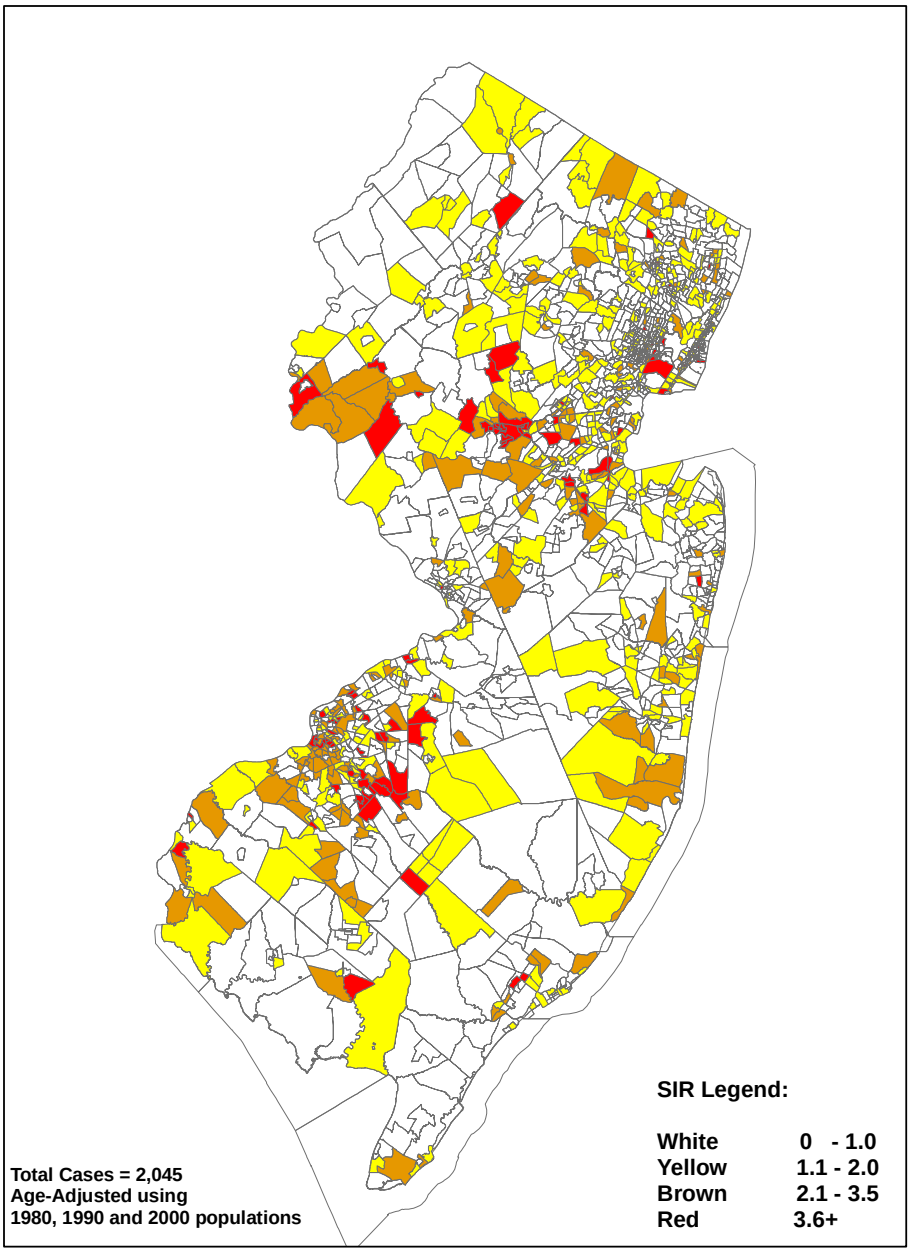
This map was generated as part of the CDC-funded Environmental and Health Effects Tracking demonstration project. This cluster analysis should be considered to be exploratory only, as results are dependent on the software parameters used, data completeness, and geocoding success rates.

Figure 24. Male Mesothelioma, 79-01
Limited to Maximum 1% Population at Risk



This map was generated as part of the CDC-funded Environmental and Health Effects Tracking demonstration project. This cluster analysis should be considered to be exploratory only, as results are dependent on the software parameters used, data completeness, and geocoding success rates.

Figure 25. Male Mesothelioma Census Tract SIRs, 1979-2001



This map was generated as part of the CDC-funded Environmental and Health Effects Tracking demonstration project. This analysis should be considered to be exploratory only, as results are dependent on data completeness and geocoding success rates.

Figure 26. Percent of Case Loss by County, 1979-1990

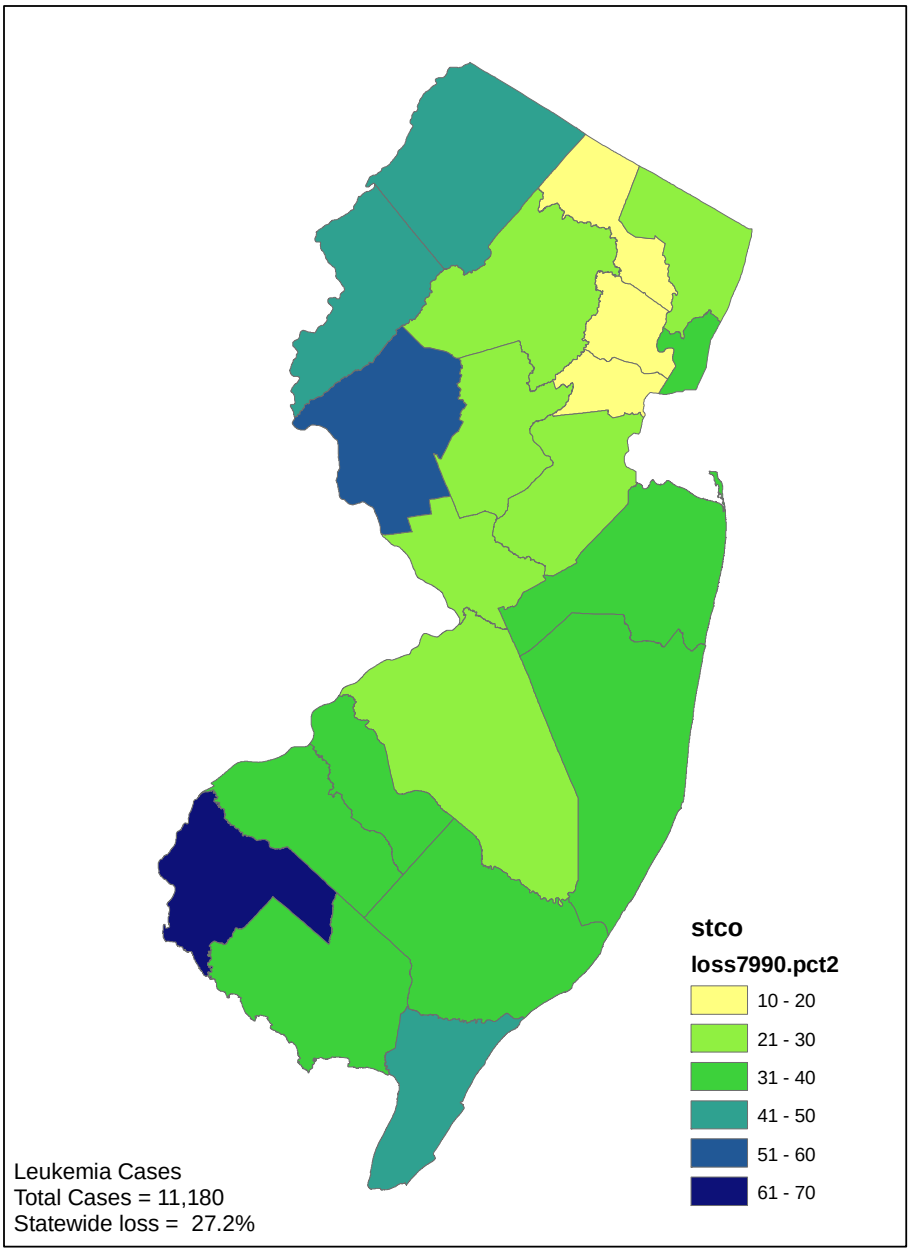


Figure 27. Percent of Case Loss by County, 1991-2001