Governor's Cancer Research Initiative

Cancer Incidence Report
for the Warren County Study Area

Albany, New York

August 2019

Executive Summary

This report summarizes cancer patterns and trends for Warren County, NY. New York State Department of Health (DOH) researchers investigated Warren County because it had the highest rate of all cancers combined in New York State (NYS) based on 2011-2015 data. This investigation was conducted as part of Governor Cuomo's Cancer Research Initiative announced in October 2017, which examined cancer trends and the potential causes of cancer in four regions of the state that have higher cancer rates, based on 2011-2015 data.

During the Warren County Investigation, DOH obtained input from interested members of the community. Researchers met with community members to present the design, goals, and approaches of the investigation. Community members and stakeholders provided input at meetings and emailed additional feedback.

DOH will use these findings to work with partners to enhance community cancer prevention, recommend appropriate screening efforts, and support access to appropriate high-quality health care.

What was Evaluated

Sociodemographic Data

DOH researchers examined data about the population, such as race, ethnicity, age, education, and income, to see if these factors could be related to higher cancer rates.

Behavioral, Healthcare and Occupational Data

DOH researchers reviewed available data about behavioral, healthcare and occupational factors known to be related to cancer. These included available information about smoking, obesity, alcohol use, diet, physical activity, occupation, and medical care access and practices.

Environmental Data

DOH researchers worked with the Department of Environmental Conservation (DEC) to review available environmental data to look for unusual patterns or trends in Warren County. Data included outdoor air pollutants, radon concentrations in indoor air, drinking water contaminants, industrial and inactive hazardous waste disposal sites, and traffic density.

Cancer Data

DOH researchers applied a two-step selection process to Cancer Registry data and chose nine types of cancer for in-depth examination. Oral cancer, colorectal cancer, laryngeal cancer, lung cancer, brain and other nervous system cancer, and thyroid cancer were selected because their overall or sex-specific incidence rates were statistically significantly higher in Warren County

than in New York State excluding New York City (NYS excluding NYC). Esophageal cancer, melanoma of the skin, and leukemia were added to the target list because their overall or sex-specific incidence rates were significantly higher than the NYS rates and the excess was at least 40%. For each type of cancer, the evaluation included cancer trends over time; age and gender of patients diagnosed with cancer; and characteristics of the cancer, such as type of cells that were cancerous, tumor size, and stage of disease at the time of diagnosis.

Findings

Sociodemographic Factors

Review of population data showed that the sociodemographic makeup of Warren County more closely resembles that of NYS excluding NYC than that of NYS. Thus, NYS excluding NYC is the more appropriate comparison area for Warren County. However, the lack of racial and ethnic diversity, as well as the low prevalence of foreign nativity, distinguishes Warren County from NYS excluding NYC.

Behavioral, Healthcare and Occupational Factors

Behavior and Lifestyle. Behavioral surveillance data indicate that compared to NYS excluding NYC, Warren County residents were more likely to be current smokers, engage in leisure time physical activity, and have health care coverage. Furthermore, a significantly higher percentage of women in Warren County were overweight or obese. Overall, Warren County was ranked relatively low with respect to a multi-element composite measure of health behaviors, indicating less healthy lifestyles.

Healthcare System. Using information on various healthcare-related metrics, Warren County was placed in the top tier among the 57 counties of NYS excluding NYC in a national county ranking program.

Occupation. Results from survey data on occupations showed that compared to NYS excluding NYC, a slightly higher percentage of residents in Warren County were engaged in occupations associated with a higher probability of workplace exposures. However, the percentages in Warren County were based on a small number of respondents and therefore these differences may not be meaningful. In addition, analysis of asbestosis hospitalization rates indicates that past exposure to asbestos is unlikely to have been elevated in Warren County.

Environmental Factors

Outdoor Air Pollution. Historical monitored air quality data for 1973-1996 indicated that outdoor air in Warren County met national air quality standards. Evaluation of model-predicted cancer risks associated with inhalation exposure to hazardous air pollutants that are known or likely human carcinogens generally found low risk of cancer. Additionally, estimated inhalation cancer risks associated with outdoor air pollution in Warren County were similar or lower than

in NYS excluding NYC and in NYS.

Radon in Indoor Air. Radon is the second leading cause of lung cancer after smoking. Average radon concentrations in Warren County were lower in comparison to both NYS excluding NYC and NYS. Radon is unlikely to explain the excess lung cancer risk in Warren County.

Drinking Water Quality. Researchers evaluated routine sampling data from 31 active public water systems in Warren County. Results showed that in general these water systems met safe drinking water standards and were in compliance. However, contaminant standards were exceeded at two public water systems. These violations were time-limited and quickly resolved. Furthermore, the contaminants that were involved are not associated with the cancers under study. Review of available data related to sampling for unregulated contaminants, based on the United States Environmental Protection Agency's (EPA's) Unregulated Contaminant Monitoring Rule (UCMR) program, showed public water systems tested in Warren County had levels below EPA reference concentrations.

Industrial and Inactive Hazardous Waste Disposal Sites. Researchers reviewed information for 22 sites in Warren County, including sites that were of concern to the public. This evaluation found no evidence suggesting that contamination from these remedial sites is causing widespread exposures in Warren County.

Traffic. Information from the traffic monitoring program was used to estimate the number of people living within 500 meters of roads with various traffic volumes. The proportion of Warren County residents living in proximity to heavily trafficked roads was considerably smaller than in NYS excluding NYC and in NYS.

Elevation in Cancer Incidence

Oral (Mouth and Throat) Cancer. The five-year rates of oral cancer were statistically significantly above the rates for NYS excluding NYC in the 2001-2005, 2006-2010 and 2011-2015 time periods. During the 2011-2015 period, the excess was observed in people aged 50-64 years, with regional-stage tumors, and with squamous cell carcinomas.

According to the scientific literature, oral cancer is associated with all forms of tobacco use, including smoking, snuff, and chewing tobacco. Most oral cancer patients in Warren County were current or former tobacco users.

Alcohol consumption is another important risk factor for oral cancer. People who are heavy users of both tobacco and alcohol are at highest risk. Population-level survey results also support that alcohol consumption, both independently and in conjunction with smoking, may account for some of the Warren County excess in oral cancer.

Infection with the human papillomavirus (HPV) is another risk factor for oral cancer. Rates for HPV-related squamous cell tumors were statistically significantly higher in Warren County than

in NYS excluding NYC in 2011-2015. However, data were insufficient to evaluate the contribution of HPV infection to the oral cancer excess, particularly because those cancers associated with HPV are also associated with alcohol and tobacco use.

Results from the environmental investigation did not show any unusual environmental exposures that could explain the county-wide excess in oral cancers in Warren County.

Esophageal Cancer. In 2011-2015 the incidence rate of esophageal cancer for Warren County was comparable to the rate for NYS excluding NYC, but significantly higher than the rate for NYS. These rates and analyses are based on a relatively small number of cases diagnosed each year in Warren County. The excess was fully attributable to men, distant-stage tumors, and squamous cell tumors.

According to the literature, smoking and alcohol use account for as much as 90% of squamous cell esophageal cancers. Most of the elevation in esophageal cancer was of the squamous cell carcinoma type, and most Warren County men diagnosed with this cancer were current or former smokers. Population-level survey results also support that alcohol consumption, both independently and in conjunction with smoking, may account for some of the Warren County excess in esophageal cancer.

Colorectal (Colon and Rectum) Cancer. Since 1999, the rates of colorectal cancer in Warren County and NYS excluding NYC have been declining. However, the incidence rate among women in Warren County in 2011-2015 was statistically significantly higher than in NYS excluding NYC. The marked excess was in women aged 20-49 years. Most colorectal cancers in women aged 20-49 were treatable, local-stage tumors indicating extensive clinical care for young symptomatic patients.

The literature estimates that up to half of early-onset colorectal cancers may be related to hereditary cancer syndromes or familial colorectal cancer. However, data were insufficient to evaluate the contribution of genetic factors to the excess of colorectal cancer.

According to the literature, colorectal cancer is also associated with smoking, heavy alcohol use, and physical inactivity. Moreover, studies suggest diet may be a risk factor, particularly a diet consisting heavily of red or processed meats and low on fruits, vegetables and fiber. People who are overweight or obese also have a greater risk of developing colorectal cancer. Population-level survey results for Warren County also support that alcohol consumption, both independently and in conjunction with smoking, and obesity may account for some of the Warren County excess in colorectal cancer.

Results from the environmental investigation did not show any unusual environmental exposures that could explain the county-wide excess of colorectal cancers in Warren County.

Laryngeal (Larynx, Voice Box) Cancer. Rates of laryngeal cancer in Warren County were statistically significantly higher than in NYS excluding NYC in 2006-2010 and 2011-2015. The

relative elevation in Warren County is in part due to declining laryngeal cancer incidence in NYS excluding NYC. The excess cancers in Warren County were observed mainly in men and were almost entirely limited to those under age 65. Nearly all excess cancer cases were diagnosed at a localized stage.

According to the literature, the strongest risk factor for laryngeal cancer is smoking. In Warren County, almost all laryngeal cancer patients were current or former tobacco users.

Laryngeal cancer is also strongly associated with alcohol use. Population-level survey results support that alcohol consumption, both independently or synergistically with smoking, may account for some of the Warren County excess in laryngeal cancer.

Researchers considered occupational exposures to sulfuric acid and asbestos, known risk factors for laryngeal cancer, because both mining and pulp production use these chemicals in small quantities in their operations and these industries used to operate in Warren County. Data were insufficient to examine this possible factor directly. Indirect evidence based on asbestosis hospitalization rates suggests that past exposure to asbestos in Warren County was not elevated relative to NYS excluding NYC. Therefore, the impact of higher occupational exposure to asbestos on the excess of laryngeal cancer in Warren County would probably be minor.

Lung Cancer. Lung cancer rates in Warren County were statistically significantly higher than in NYS excluding NYC between 2011 and 2015. The marked elevation in Warren County is mostly driven by declining lung cancer incidence in NYS excluding NYC. The excess of lung cancer in Warren County is mainly associated with men, and all adults under age 65. The highest elevation in rates was observed for individuals 20-49 years of age.

Rates of the three major subtypes of lung cancer that are strongly associated with smoking were significantly elevated (i.e., squamous cell, small cell, and large cell carcinomas). An overwhelming majority of lung cancer patients in Warren County had a history of tobacco use at some time in their life, with the highest percentages among patients with small cell carcinoma and squamous cell carcinoma, the two subtypes most strongly related to cigarette smoking.

Researchers examined the rates of people diagnosed with lung cancer in Warren County who had a prior history of cancer, because radiation exposure is another key risk factor for lung cancer and cancer patients are frequently treated with radiation. The results did not show a significant difference between Warren County and NYS excluding NYC. Thus, it is unlikely that the excess in lung cancer incidence in Warren County can be attributed to radiation treatment for a prior tumor.

Exposure to air pollutants has been associated with lung cancer. Review of the modeled data showed that cancer risks from inhalation exposure to hazardous air pollutants were lower or similar to levels in NYS excluding NYC. Furthermore, the proportion of residents who live in

proximity to high traffic roads was lower in Warren County. Therefore, available data on outdoor air quality indicate that air pollution is unlikely to explain the elevated lung cancer rates in Warren County.

Radon is an important environmental risk factor for lung cancer. In-home radon testing results show that average radon concentrations in Warren County were generally lower than in NYS excluding NYC. Although radon may be contributing to lung cancer risk in a limited number of localities, it is unlikely to explain the lung cancer excess in Warren County.

In the literature, elevated lung cancer rates have also been seen in communities with high levels of arsenic in drinking water. Also, beryllium, cadmium, and nickel are chemicals associated with lung cancer risk. These substances were monitored during routine water quality tests, but no violations were ever issued for them. The substances for which water violations were issued (i.e., total trihalomethanes and total haloacetic acids) have not been associated with lung cancer. Therefore, contamination in drinking water is unlikely to be related to the excess in lung cancer in Warren County.

Warren County has a somewhat greater proportion of people working in occupations with a higher probability of workplace exposures to elevated levels of hazardous substances than NYS excluding NYC. However, there were insufficient data available to evaluate the possible contributions of specific occupations to the lung cancer excess in Warren County. Indirect evidence based on asbestosis hospitalization rates indicates that past exposure to asbestos in Warren County was unlikely to have been elevated compared to NYS excluding NYC.

Melanoma of the Skin. Historically, rates of melanoma in Warren County have been higher than those for NYS and NYS excluding NYC. For the 2011-2015 period, the incidence rates for Warren County and NYS excluding NYC were statistically equivalent, but the rate for Warren County was 42% higher than the rate for NYS, a statistically significant difference.

The most important risk factor for melanoma is having a light skin complexion, which is a common trait among non-Hispanic whites. When comparing data for non-Hispanic whites in NYS, NYS excluding NYC, and Warren County, rates in Warren County were not statistically different. The rates of melanoma in Warren County were elevated when race/ethnicity was not considered because Warren county residents are almost exclusively non-Hispanic white (95%), while only 76% of the population of NYS excluding NYC and 58% of the population of NYS are non-Hispanic white.

Brain Cancer. The rates of cancers of the brain and other nervous system (ONS) in Warren County are based on small numbers since these cancers are relatively rare. They did not differ significantly from NYS excluding NYC until the 2011-2015 period. Rates in this timeframe were statistically significantly elevated among females, and among individuals under 20 years of age when both sexes were combined. Examination by cell type showed that the rate of pilocytic astrocytoma among individuals 0-19 years of age was almost five times higher in Warren County than in NYS excluding NYC. However, this rate was only based on four cases. Pilocytic

astrocytomas accounted for 75% of the excess in brain and ONS cancers in the under 20 age group in Warren County.

Researchers examined the rates of people diagnosed with brain cancer in Warren County who had a prior history of cancer because radiation exposure is a key risk factor for brain and ONS cancer and cancer patients are frequently treated with radiation. The results did not show a significant difference between Warren County and NYS excluding NYC.

Results from the environmental investigation did not show any unusual environmental exposures that could explain the county-wide excess in brain and ONS cancers in Warren County.

Thyroid Cancer. Thyroid cancer rates in Warren County and in NYS excluding NYC have been increasing for decades. The five-year rate in Warren County was 30% higher than in NYS excluding NYC in 2011-2015. Thyroid cancer is more common in women than in men and becomes more common among people 30 years of age or older. Although rates in Warren County were elevated in women of all ages, the elevation was statistically significant only among women aged 65 and older.

Papillary carcinoma is the most common type of thyroid cancer in NYS and Warren County. Papillary carcinoma was responsible for nearly all the increase in cancers in Warren County and in NYS excluding NYC. This cancer is slow growing and rarely fatal. Nearly all the increase in Warren County thyroid cancers has been for tumors small enough to be considered subclinical, meaning they were small enough to cause no symptoms.

According to the scientific literature, the primary risk factor for thyroid cancer is medical system practices. These include the use of diagnostic imaging, cancer screening, and cancer diagnoses occurring post-surgery. Increases in thyroid cancer correspond directly to an increase in routine diagnostic imaging – specifically, diagnostic imaging with a neck ultrasound, or another form of imaging in the absence of symptoms. According to an article in the *New England Journal of Medicine,* 70-80% of female thyroid cancer cases and 45% of male thyroid cancer cases diagnosed in the US fall into this category. Researchers attempted to measure the volume of diagnostic imaging in New York and Warren County, but data were insufficient. Survey data showed that a higher proportion of adults in Warren County had health care coverage than those in NYS excluding NYC. Additionally, in recent years, Warren County has been ranked high on a composite metric of access to care and quality of care. Thus, high healthcare utilization in Warren County may be contributing to higher thyroid cancer rates.

Researchers examined the proportion of female thyroid cancer patients in Warren County who had a prior history of cancer because radiation exposure is a key risk factor for thyroid cancer and cancer patients are frequently treated with radiation. The results did not show a significant difference in rates between Warren County and NYS excluding NYC.

There is evidence that an excess in body fat is associated with thyroid cancer, although the increase in risk is rather modest. Based on population-level survey results, its contribution to the thyroid cancer excess in Warren County would be minor.

Results from the environmental investigation did not show any unusual environmental exposures that could explain the county-wide excess in thyroid cancers in Warren County.

Leukemia. Leukemia was selected for study based on an excess of over 40% among females in Warren County relative to females in NYS. Leukemia incidence rates vary markedly by race/ethnicity. Virtually all leukemia cases in Warren County were non-Hispanic white. When the analysis was limited to non-Hispanic white females, the leukemia rate for women in Warren County was elevated during 2011-2015, but this rate was not statistically different from the rate for women in NYS excluding NYC or NYS. Most of the observed excess was attributable to an excess in chronic lymphocytic leukemia (CLL). However, the CLL incidence rates for non-Hispanic white females in Warren County and in NYS excluding NYC were also not statistically different.

CLL is the most common type of leukemia in adults. Family history is a strong risk factor, but other causes of CLL are uncertain. CLL can be detected by routine blood testing, before symptoms appear. Cancer data do not suggest that the excess could be due to greater reporting by either physician practices or independent clinical laboratories in the study area. The observed excess may in part be attributed to greater contact with the medical care system among Warren County residents.

Researchers observed a statistically significant excess in the CLL rate for women 20-49 years of age in Warren County compared to NYS excluding NYC. They also observed a deficit in the CLL incidence rate for females 50-64 years of age. This pattern suggests a shift toward earlier diagnosis for some CLL cases.

Survey data suggest that a greater proportion of Warren County residents under age 65 had health care coverage, which would improve access to medical care. This may in part explain the elevation in the CLL rate among women 20-49 years of age.

Given the lack of a statistically significant excess in leukemia among non-Hispanic white females in Warren County, and the highly variable annual leukemia incidence rates, it is likely that the excess observed for 2011-2015 represents an anomaly. Examination of 2012-2016 cancer data supports this conclusion.

Conclusions

- It is likely that a higher proportion of current and former tobacco use contributed to the elevated rates of lung, laryngeal, esophageal, and oral cancers in Warren County, which are four cancers most strongly associated with tobacco use. In 2011-2015, the elevations in the rates for these cancers were more often observed in men.

- Alcohol consumption, independently or through a synergetic effect with tobacco use, might have contributed to the excess of oral, esophageal, and laryngeal cancers in Warren County, particularly among men.
- HPV infection could also have contributed to the oral cancer excess.
- Most of the elevation in thyroid cancer rates among women in Warren County is likely due to increased detection of small papillary tumors by medical imaging and other diagnostic techniques.
- The higher proportion of overweight or obese women in Warren County could also have contributed to the excess in female thyroid cancer incidence as well as the excess in female colorectal cancer incidence.
- The excess in leukemia rates among women in Warren County may represent a time-limited anomaly.
- The investigation found no factors that might account for the elevated incidence of cancers of the brain and ONS among females in Warren County. There were also no factors that might explain the higher incidence of pilocytic astrocytoma tumors among individuals less than 20 years of age. DOH will continue to monitor the incidence of brain and ONS cancers in Warren County.
- Results from the environmental investigation did not show any unusual environmental exposures that could explain the elevated cancer incidence rates in Warren County.

Recommendations

The recommendations below are divided into two main sections: 1) recommended actions to address the specific cancers that were elevated in the Warren County Study Area, and 2) recommended actions to address all cancer types throughout New York State. Many of the recommended activities are aligned with two existing State plans that address cancer prevention and control, the *New York State 2018-2023 Comprehensive Cancer Control Plan*, and the *New York State Prevention Agenda 2019-2024*.

Recommended Actions Based on Specific Cancers Elevated in the Warren County Study Area

Health Promotion and Cancer Prevention

Tobacco Prevention

Recommendation: Prevent initiation of tobacco use, including combustible tobacco and electronic vaping products by youth and young adults.

Recommendation: Promote tobacco use cessation, especially among populations disproportionately affected by tobacco use including: low socioeconomic status; frequent mental distress/substance use disorder; lesbian, gay, bisexual and transgender; and disability.

Recommendation: Eliminate exposure to secondhand smoke and exposure to secondhand aerosol/emissions from electronic vapor products.

Alcohol Use

Recommendation: Implement environmental approaches, including reducing alcohol access, implementing responsible beverage services, reducing risk of drinking and driving, and restricting underage alcohol access.

Recommendation: Collaborate with partners and key stakeholders to educate the public, including youth and young adults, on cancer risk related to alcohol usage.

Recommendation: Provide personalized feedback about the risks and consequences of excessive drinking through the use of electronic screening and behavioral counseling interventions in healthcare settings, schools, and emergency rooms.

Recommendation: Among persons meeting the diagnostic criteria for alcohol dependence, promote the use of alcohol misuse screening and brief behavioral counseling interventions via traditional (face to face) or electronic means, and referrals to specialty treatment.

Healthy Nutrition and Physical Activity

Recommendation: Promote healthy eating and food security by:

- Increasing access to healthy and affordable foods and beverages,
- Increasing skills and knowledge to support healthy food and beverage choices,
- Increasing food security, and
- Increasing awareness of DOH sportfish advisories to promote healthier fish consumption choices while reducing chemical exposures (https://www.health.ny.gov/environmental/outdoors/fish/health_advisories/).

Recommendation: Increase physical activity by:

- Improving community environments that support active transportation and recreational physical activity for people of all ages and abilities,
- Promoting school, child care, and worksite environments that support physical activity for people of all ages and abilities, and
- Increasing access, for people of all ages and abilities, to safe indoor and/or outdoor places for physical activity.

HPV Vaccination

Recommendation: Develop and implement educational campaigns targeted to adolescents and adults regarding the benefits and risks of HPV vaccine.

Recommendation: Maximize use of the New York State Immunization Information System (NYSIIS) and the Citywide Immunization Registry (CIR) for vaccine documentation, assessment, decision support, reminders and recall.

Recommendation: Adopt local HPV policies which support HPV vaccination in adolescents and expand vaccine availability to new venues such as more healthcare settings and schools.

Exposure to Ultraviolet (UV) Radiation

Recommendation: Promote educational initiatives that stress sun safety messages and provide clear information about the cancer risk associated with indoor tanning to decrease exposure to UV radiation for people of all ages, especially initiatives that target children, adolescents, young adults, parents, healthcare providers, and summer camp instructors.

Recommendation: Implement environmental changes for sun protection in outdoor settings such as access to shade and sunscreen in playgrounds, schools, summer camps, and other outdoor recreational settings, and increase the availability of sun protection in occupational settings for outdoor workers.

Recommendation: Promote awareness of, and compliance with, NYS's tanning law restricting minors from the use of indoor tanning facilities.

Cancer Screening and Early Detection

Lung Cancer Screening

Recommendation: Educate men and women who meet the criteria for lung cancer screening about the benefits and risks of screening to help them make informed decisions.

Recommendation: Healthcare providers need tools and support to engage with patients who may benefit from screening, and facilities adopting lung cancer screening programs should be following national guidelines for a quality program.

Colorectal Cancer Screening

Recommendation: Educate men and women who meet the criteria for colorectal cancer screening about the benefits and risks of screening to help them make informed decisions.

Recommendation: Educate providers and the public that there are many testing options for colorectal cancer screening including take-home tests.

Recommendation: Reduce cost-related barriers to screening by educating providers and the public that health insurance plans in New York State are required to cover screening, and

for those who are uninsured, the New York State Cancer Services Program (CSP) provides free colorectal cancer screening to men and women age 50 and older.

Recommendation: Support primary care practices and staff to implement evidence-based strategies outlined in the Guide to Community Preventive Services such as the use of patient and provider screening reminders.

Thyroid Cancer Screening

Recommendation: The U.S. Preventive Services Task Force recommends *against* screening for thyroid cancer in asymptomatic adults. Educate the public and healthcare providers about recommendations *against* thyroid cancer screening in average risk, asymptomatic adults.

Healthy and Safe Environment

Radon Testing and Mitigation

Recommendation: Improve the public's awareness about the relationship between indoor radon exposure and lung cancer by conducting outreach and education about building testing and remediation. Promote the DOH's free and low-cost radon test kit programs, provision of test kits at half price to schools and daycares, and free test kits as part of the DOH's Healthy Neighborhoods Program and other grant-funded programs.

Recommendation: Explore local level policy and/or code adoption to require radon resistant construction in high radon areas.

Recommendation: Increase the number of physicians that ask their patients if they have had their homes tested for radon and refer them to the DOH, as needed. Add radon testing questions to routine electronic medical questionnaires.

Radiation from Medical Imaging

Recommendation: Increase awareness of such programs as NYS's "Image Gently" and the national "Image Wisely" campaigns that educate physicians and the public about potential radiation exposure from CT scans and X-rays in both children and adults.

Safety in the Workplace

Recommendation: Develop targeted occupational safety and health training programs for employers and workers in high-risk jobs.

Recommendation: Incorporate industry and occupation into electronic health records and other patient-oriented databases.

Recommended Actions to Reduce the Burden of All Cancers Statewide

Below are highlights of what individuals can do and what DOH and its partner organizations are doing. For more information on activities, by type of organization, that New Yorkers can do to help reduce the burden of cancer, see: https://www.health.ny.gov/diseases/cancer/consortium/docs/2018-2023_comp_cancer_control_plan.pdf#page=62.

For All New Yorkers

The following are things that all individuals can do to reduce their risk of cancer:

- If you use tobacco, quit. If you don't use tobacco, don't start.
- Eat nutritious meals that include fruits, vegetables and whole grains.
- Get moving for at least 30 minutes a day on five or more days each week.
- Use sunscreen, monitor sun exposure and avoid tanning salons.
- Limit alcohol use.
- Get cancer-preventive vaccines such as hepatitis B and HPV.
- Learn your family health history (if possible) and discuss with your healthcare provider whether genetic counseling might be right for you.
- Discuss what cancer screening tests might be right for you with your healthcare provider.
- Test your home for radon.
- For women of child-bearing age, know the benefits of breastfeeding and, if possible, breast-feed infants exclusively for at least the first six months of life.

For NYS Department of Health and Partner Organizations

Cancer Surveillance: The New York State Cancer Registry (NYSCR) was designated by the CDC (Centers for Disease Control and Prevention) as a Registry of Excellence and has achieved Gold-level certification since 1998. In 2018, the NYSCR became a member of the National Cancer Institute's Surveillance, Epidemiology and End Results Program (SEER), the nation's preeminent source of population-based cancer data.

> **Recommendation:** Continue to meet the highest cancer registry standards for timeliness, completeness and quality of data, and make these data available to researchers, clinicians, public health officials, legislators, policymakers, community groups and the public.

Environmental Health: DOH's Center for Environmental Health (CEH) works collaboratively with other agencies including the NYS Department of Environmental Conservation, the federal Environmental Protection Agency (EPA), the Centers for Disease Control and Prevention (CDC), and the Agency for Toxic Substance and Disease Registry (ATSDR). CEH programs evaluate health effects associated with environmental exposures, develop policies, and maintain a variety of programs to reduce and eliminate exposures.

> **Recommendation:** Continue to identify and assess potential exposures throughout the

state and take action to reduce those exposures. NYS will continue to support programs to promote and maintain clean air, clean water and reduce human exposures to environmental hazards, with particular attention to the needs of environmental justice communities.

Recommendation: Promote awareness of programs and initiatives to reduce environmental hazards in our communities.

Statewide Initiatives: The overarching goals of cancer prevention and control efforts in New York State are detailed in two State plans, the *New York State 2018-2023 Comprehensive Cancer Control Plan*, and the *New York State Prevention Agenda 2019-2024*.

Recommendation: Continue to work with partners to implement cancer-related initiatives.

- More details about the NYS Comprehensive Cancer Control Plan can be found at: https://www.health.ny.gov/diseases/cancer/consortium/index.htm.
- More details about the NYS Prevention Agenda can be found at: https://www.health.ny.gov/prevention/prevention_agenda/2019-2024/.

More Information

More details about the Governor's Cancer Research Initiative and this investigation may be found at https://www.health.ny.gov/diseases/cancer/cancer_research_initiative/.

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This report is available online at:
https://health.ny.gov/diseases/cancer/docs/warren_final_report_2019.pdf.

For questions and comments please send an email to canmap@health.ny.gov.

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1. Introduction

About the Governor's Cancer Research Initiative

The Governor's Cancer Research Initiative, announced in October 2017, was undertaken to examine cancer trends and the potential causes of cancer in four regions of the state that have a higher incidence of cancer. The four regions are: Warren County in northeastern New York, Staten Island (Richmond County) in New York City, an area of East Buffalo and West Cheektowaga in western New York, and an area including the communities of Centereach, Farmingville and Selden on Long Island (Fig. 1-1). As part of the initiative, staff from the New York State Department of Health (DOH) conducted a detailed review of cancer data for each area. Staff also examined information on demographic, socioeconomic, behavioral and occupational factors that might be contributing to the higher incidence of specific types of cancer. In addition, Department staff worked with the New York State Department of Environmental Conservation (DEC) to identify potential sources of environmental contaminants that may be affecting cancer rates. The Department will use the results of the initiative to enhance community cancer prevention and screening efforts and support access to appropriate high-quality health care.

Figure 1-1 Location of the Four Study Areas in the Governor's Cancer Research Initiative Project

During the course of the initiative, the Department received input from interested members of the four communities on potential avenues of investigation and possible sources of the elevated cancer rates. In July 2018, Department staff met with community members and stakeholders in each study area to present the design, goals and approaches for each investigation. At the meetings and afterwards, community members and stakeholders provided input that was taken into account during the investigation.

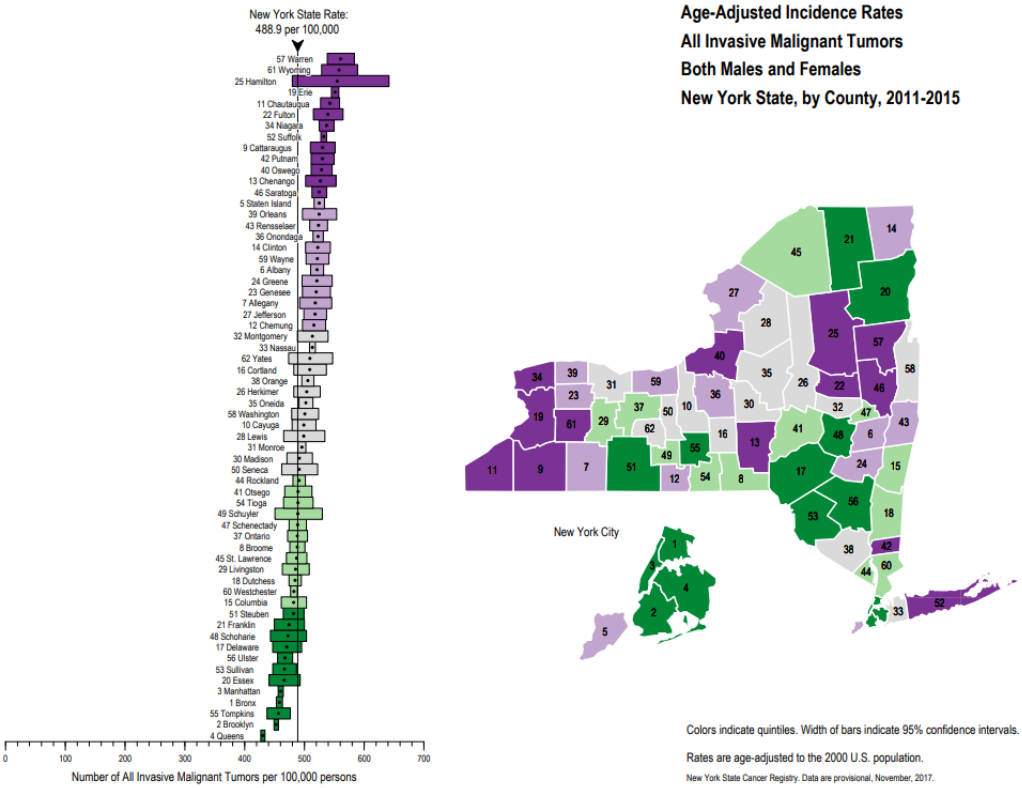
Cancer is one of the most common chronic diseases in New York State (NYS), and is second only to heart disease as the leading cause of death. Each year, about 110,000 New Yorkers are diagnosed with cancer. It has been estimated that 40 in 100 men and 38 in 100 women will be diagnosed with cancer at some point in their lives.[1] Cancer is not a single disease, but a collection of over 100 different diseases, each with its own occurrence patterns, effective treatments, outlooks and sets of causes. Incidence patterns for different cancers are affected by a number of factors, including those related to socio-demographics, personal behaviors,

occupation and the environment. Patterns may also be affected by differences in how cancer is diagnosed across the state or over time. This report seeks to investigate and provide some insight into potential reasons for the higher-than-expected incidence of certain cancers in some areas of New York State, based on a review of available data sources.

Selection of Warren County as the Study Area

The New York State Cancer Registry (NYSCR) reported that, between 2011 and 2015, a total of 2,564 primary malignant tumors were diagnosed among residents of Warren County, yielding an age-adjusted incidence rate of 560.6 per 100,000 persons, the highest of any county in the state (Fig. 1-2). Warren County was selected for inclusion in the Governor's Cancer Research Initiative largely on this basis.

Figure 1-2 Overall Cancer Incidence Rate by County in New York State, 2011-2015



Selection of Cancer Sites to be Examined

A two-step selection process was used to determine which types of cancer would be the target for in-depth examination. First, rates in Warren County were compared with those in New York State excluding New York City (NYS excluding NYC). New York City was excluded because its

demographics differ markedly from the rest of the state, particularly in terms of its racial and ethnic composition and number of persons born in other countries, all of which are associated with cancer incidence.

Types of cancer where the overall or sex-specific incidence rate was statistically significantly higher in Warren County than in NYS excluding NYC were selected for further examination. There were six such types: (1) oral cavity and pharynx (34% elevation overall), (2) colorectal (25% in females), (3) larynx (88% overall, and 81% in males), (4) lung and bronchus (18% overall, and 24% in males), (5) brain and other nervous system (67% overall, and 115% in females), and (6) thyroid (30% overall, and 37% in females). These cancer types and percent elevations are also listed in Table 1-1.

Second, rates in Warren County were compared with those in New York State as a whole. Any type of cancer where the overall or sex-specific incidence rate was significantly higher than the New York State rate and the excess was at least 40% were additionally selected. This resulted in the additional selection of three cancer types: (1) esophagus (48% elevation overall, and 62% in males), (2) melanoma of the skin (42% overall, and 45% in males), and (3) leukemia (49% in females).

The incidence rates for these nine cancer types combined were 237.0 per 100,000 persons overall, 262.3 in males, and 217.1 in females. They accounted for 86%, 80% and 90% of the excesses above the rates for NYS excluding NYC, for all persons, males, and females, respectively.

Table 1-1 Cancer Types and Percent Elevations in Incidence Rates,[1] Warren County versus New York State excluding New York City, and New York State, by Sex, 2011-2015

Cancer Site	Warren vs. NYS excl. NYC[2]			Warren vs. NYS[3]		
	All	Male	Female	All	Male	Female
Oral cavity and pharynx	33.9					
Esophagus				48.0	62.4	
Colorectal			24.7			
Larynx	87.7	80.5				
Lung and bronchus	18.4	24.4				
Melanoma of the skin				41.6	45.2	
Brain & other nervous system	66.8		115.4			
Thyroid	30.4		37.0			
Leukemia						48.5

[1] Incidence rates are age-adjusted to the 2000 US standard population. Complete data for all types are presented in Tables A-II-1 to A-II-3 in Appendix II.

[2] Values with significant elevations are shown.

[3] Values with significant elevations of at least 40% are shown.

2. Approach

The following sections provide an overview of the approach taken to explore the excess of cancer incidence in Warren County. A number of data sources were evaluated and analyzed to gather information for this report. A brief description of these data sources can be found in Appendix I. Additional, more detailed information about environmental data can be found in Appendix IV.

Evaluation of Demographic, Behavioral, Healthcare, and Occupational Factors

Previous studies show that cancer incidence rates vary according to population-level sociodemographic characteristics (e.g., the distribution of race, age, and poverty level in an area). Health risk behaviors, such as smoking, drinking alcohol, poor dietary habits, and obesity, are important modifiable risk factors in the development of many different types of cancer. Following recommended screening guidelines can lower the incidence for some specific types of cancer (i.e., cervical and colorectal cancers). Access and interaction with the health care system can influence the likelihood that someone could be diagnosed with certain cancers, such as thyroid cancer or chronic leukemias, before any symptoms appear. In addition, exposure to carcinogenic substances in the workplace or the environment is another risk factor for cancer. These pieces of information can be helpful in trying to understand why cancer incidence may be higher in a particular area.

Therefore, a comprehensive assessment of the characteristics of Warren County was conducted with NYS excluding NYC and/or NYS as the reference population(s), using a variety of data sources, such as the American Community Survey (ACS), the NYS expanded Behavioral Risk Factor Surveillance System (e-BRFSS), the NYS Statewide Planning and Research Cooperative System (SPARCS), and the County Health Rankings & Roadmaps Program. Statistical testing was conducted to evaluate

- **What is statistical testing?**

Statistical testing is used to determine the probability that a measurement in a target population is higher (i.e., excess) or lower (i.e., deficit) than that in a reference population. If the probability of observing an excess or deficit if none exists is less than 0.05 (p-value<0.05), the difference between the two measurements is deemed to be statistically significant. Otherwise, the two measurements are considered comparable.

- **What is a confidence interval?**

Confidence interval (CI) is an indicator of the stability and range of plausible values of a statistical estimate. A wider interval indicates a less stable estimate. A two-sided CI is an interval within which the true value is expected to lie, i.e., between the lower (L) and upper (U) bounds. When applied to a risk (or rate) ratio, a confidence interval which does not include the value 1 indicates that the risk (or rate) in the study area is statistically different from the rate in the reference area.

whether any difference in indicator estimates in the e-BRFSS were likely to be real or due to chance.

Review of Environmental Factors

To assess whether residents of Warren County have a history of unusual environmental hazards and potential exposures in comparison to NYS excluding NYC and/or NYS, extensive reviews of available data were conducted by staff from the DOH and the DEC. These evaluations focused on 1) outdoor air pollution, 2) radon in indoor air, 3) drinking water quality from community water systems, and 4) remedial sites in Warren County. In addition, specific environmental concerns (e.g., impact of traffic pollution) raised by community members were explored.

Outdoor Air Pollution

Federal and state air pollution control programs have at their disposal a variety of air pollutant data collection and model estimation systems that have evolved over time. The following data sources were used in this evaluation to provide indicators of current and historical air quality in Warren County as well as in NYS more generally: 1) The US Environmental Protection Agency's (EPA) Air Quality System (AQS) database, 2) EPA's National-scale Air Toxics Assessment (NATA) data, and 3) relevant air quality data collected by special studies.

The EPA's AQS database contains data from air quality monitoring stations across New York State at various locations and timeframes since 1965. This database currently includes sulfur dioxide, ozone, carbon monoxide, nitrogen dioxide, lead, total suspended particulates, and particulate matter less than 2.5 and 10 microns ($PM_{2.5}$ & PM_{10}) in diameter. Although toxicological data do not indicate that these criteria air pollutants are environmental risk factors for cancer, they were evaluated since they provide the longest historical measurements of air pollution.

For the NATA program**,** EPA applies a complex dispersion model to source-specific emissions and meteorological data to estimate chemical-specific air concentrations and inhalation cancer risks for small geographic areas known as census tracts across the US. However, the NATA results are best applied to larger areas such as counties, states and the nation. The number of EPA-designated hazardous air pollutants (HAPs) included in the model has varied from 32 in 1996 to 180 plus diesel particulate matter in 2014. This evaluation reviewed data on selected HAPs from the 2011 and 2014 NATA datasets since these data represent reasonable estimates of potential inhalation exposures and risks. The selected HAPs are considered known or likely human carcinogens based on authoritative review by agencies such as the International Agency for Research on Cancer (IACR), EPA's Integrated Risk Information System (IRIS), and US Department of Health and Human Services' National Toxicology Program (NTP).

In addition, one special study conducted previously in the Warren County area, the Hudson River Communities Project, was also reviewed for this evaluation.

Radon in Indoor Air

Radon data from indoor air tests conducted from 1987 to 2015 were used to estimate various measures for Warren County, NYS excluding NYC, and NYS. The summary measures of radon test results include the total number of tests conducted, average and maximum test values, percent of tests that were at or above the action level of 4 pCi/L, and the number of tests and average radon values by floor level (basement and first floor). DOH staff also prepared a map for the study area to display average radon levels by census block group.

Drinking Water Quality

This review evaluated drinking water data associated with required and routine sampling conducted by community water supplies. The DOH and the federal government regulate public drinking water systems. In 1974, Congress passed the Safe Drinking Water Act that standardized the protection of drinking water on a national level. States that previously had established drinking water standards were required to make their standards at least as stringent as the national standards promulgated by the EPA. These national drinking water standards first went into effect in 1977.

The list of regulated analytes has evolved over time and includes a variety of principal organic compounds (POCs), metals, pesticides, pathogens, and other contaminants. For regulated analytes, Maximum Contaminant Levels (MCLs) have been established. A violation of a standard occurs when the established MCL is surpassed and confirmed with a follow-up sample. In certain cases, an MCL is defined as a running average of samples over a quarterly time frame. This means an individual exceedance of an MCL in one sample may not warrant a violation. Rather, an exceedance occurring over a certain time frame that reaches an average value above that of the Maximum Contaminant Level would trigger a violation.

This review evaluated sampling data for finished water at entry points to the distribution system. Staff reviewed exceedances and violations. In cases where violations were issued, details about the violations are provided. Recent data for some contaminants that are currently unregulated were also evaluated.

Industrial and Inactive Hazardous Waste Disposal Sites

DOH and DEC staff developed an inventory of inactive hazardous waste sites and brownfields sites for Warren County. Residents who participated in the public meeting in July 2018 also identified sites of concern. DOH staff evaluated the available information to determine whether people may have been exposed to any contaminants released from these sites.

Other Environmental Concerns - Traffic

Although air pollution from mobile sources is one of the emission sources included in EPA's NATA data, traffic pollution was further examined as a separate question by DOH researchers. Staff reviewed information from the NYS Department of Transportation (DOT) traffic

monitoring program, which collects information on traffic counts at fixed and temporary monitoring locations. This information is processed to create average annual daily traffic (AADT) counts for road segments along interstate highways and all NYS routes and roads that are part of the Federal Aid System. DOH staff used these traffic data and US Census population data to estimate the number of people living within 500 meters of roads in Warren County. These results were then compared to similar estimates for NYS excluding NYC, and NYS as a whole.

Investigation of Elevation in Cancer Incidence

To gain insight into possible factors that may be contributing to the elevated incidence of the nine cancers in Warren County, we took a closer look at the cancers that were identified. Since different cancers are different diseases, with different sets of risk factors and causes, analyses were done separately for each cancer of interest.

For the six types of cancers that were selected for study based on elevated incidence rates in Warren County relative to NYS excluding NYC, we used the NYS excluding NYC population as the reference population (i.e., for oral cancer, colorectal cancer, laryngeal cancer, lung cancer, brain cancer, and thyroid cancer). For esophageal cancer, melanoma of the skin, and leukemia, NYS excluding NYC and/or NYS were used as the reference population(s). All analyses of cancer data were based on an analysis of incidence rates. Unless otherwise specified, all incidence rates were age-adjusted to the 2000 US standard population. Statistical testing was conducted to evaluate whether any difference in incidence rates between

- **What is an age-adjusted incidence rate?**

Age-adjustment is a statistical process applied to rates of disease, death, injuries or other health outcomes, which allows incidence rates for communities with different age structures to be compared. Adjustment is accomplished by first calculating the rate of disease for each age group, then multiplying each age-specific rate by a corresponding age-specific weight, and finally summing across all age groups to give the age-adjusted rate.

- **What is summary stage?**

Summary staging is the most basic way of categorizing how far a cancer has spread from its point of origin. In the simplest form it has three categories: localized, regional, and distant.
A **localized** cancer is limited to the organ of origin, i.e., it has spread no farther than the organ in which it started.
At **regional** stage, the cancer has extended beyond the limits of the organ of origin. This can be either through spread into adjacent organs or surrounding tissue, or spread into nearby lymph nodes, or both.
At **distant** stage, the cancer has spread beyond adjacent organs/tissues or nearby lymph nodes. Most commonly this involves distant metastases, that is, tumor cells have broken away from the original tumor, have travelled to other parts of the body, and have begun to grow in the new location.

- **What are cancer subtypes?**

Subtypes are smaller groups that a cancer can be divided into, based on certain characteristics of the cancer cells, such as how the cancer cells look under a microscope, and whether there are certain substances in or on the cells or certain changes to the DNA of the cells.

Warren County and the appropriate reference population was likely to be real or due to chance. All cancer data were obtained from the NYS Cancer Registry (NYSCR). A description of the NYSCR can be found in Appendix I.

First, we examined trends in incidence from 1996 to 2015, for males and females combined and separately, to determine when the elevation in Warren County started and whether the trend varied by sex. We focused subsequent analyses on the 2011-2015 period. We examined incidence rates by broad age groups and by summary stage at diagnosis for males and females combined and separately. Where applicable, we examined incidence rates by histological subtype and/or tumor size.

Further review of cancer data was based on what was found in the initial reviews and what is known about the specific types of cancer. Efforts included the examination of other data contained in the NYSCR pertaining to factors such as tumor behavior, prior history of cancer, history of tobacco use, and cancer reporting sources.

Finally, we integrated the evaluation of demographic, behavioral, healthcare, and occupational factors, presented in Section 3, as well as potential environmental exposures, presented in Section 4, with the findings of the cancer analyses. The integration forms the basis of our "discussion" for each cancer section.

3. Warren County Profile

Geography

Warren County is located in the southern part of the Adirondack Mountains. Most of the county lies within the Adirondack Park, which is part of New York's Forest Preserve (Fig. 3-1). The county has a total area of 932 square miles, with 867 square miles of land and 65 square miles of water, which includes Lake George.

Figure 3-1 Map of Warren County and the Adirondack Park

https://americorpsfortheadirondacks.wordpress.com/2012/10/11/the-adirondack-park/

Sociodemographic Characteristics

According to the 2011-2015 American Community Survey, Warren County had approximately 65,000 residents. The population density was about 75 people per square mile, and the population was 49% male and 51% female. Warren County residents were somewhat older compared to NYS excluding NYC and to NYS, with 43% of residents aged 50 years and older versus 37% in NYS excluding NYC and 34% in NYS (Table 3-1). The county was disproportionately white (96% versus 81% and 65%). Hispanics or Latinos of any race accounted for only 2% of the population. Compared to both NYS excluding NYC and to NYS, Warren County had fewer residents born in foreign countries, and a higher proportion of residents who were born in NYS.

Among those 25 years and older, Warren County residents had slightly lower educational attainment compared to NYS excluding NYC and to NYS (Table 3-1). However, among those who never attended college, Warren County had a higher percentage of high school graduates, including high-school equivalency diplomas.

The median household income in Warren County was $56,798, the mean household income was $71,951, and the per capita income was $30,611 (Table 3-1). Income metrics indicate that earnings in Warren County were lower than in NYS excluding NYC and in NYS, but the percentage of Warren County's population below the federal poverty level was almost the same as in NYS excluding NYC and lower than in NYS.

Based on sociodemographic characteristics, the more appropriate comparison population for Warren County is NYS excluding NYC, and not NYS.

Table 3-1 Sociodemographic Characteristics of Warren County, New York State excluding New York City, and New York State, American Community Survey, 2011-2015

Indicator	Warren County	NYS excl. NYC	NYS
Sex (%)			
Male	49.1	49.1	48.5
Age (%)			
00-19 years	21.7	25.0	24.4
20-49 years	35.4	38.2	41.4
50-64 years	23.7	21.2	19.8
65+ years	19.1	15.5	14.3
Race (%)			
White alone	96.2	80.5	64.6
Black alone	1.2	8.9	15.6
Am. Indian, Alaska Native, Asian, Pacific Islander	1.2	4.2	8.4
Other	1.4	6.3	11.4
Ethnicity (%)			
Hispanic	2.1	10.5	18.4
Education attainment among 25 years and over (%)			
Less than high school graduate	9.1	10.3	14.4
High school graduate (includes equivalency)	33.3	28.7	26.7
Some college or associate's degree	29.4	27.9	24.7
Bachelor's degree or higher	28.2	33.1	34.2
Income ($)			
Mean household income	71,951	87,666	86,825
Median household income	56,798	N/A	59,269
Per Capita Income	30,611	33,355	33,236
Poverty (%)			
Income in the past 12 months below FPL	12.0	11.9	15.7
Tenure in occupied units (%)			
Owner occupied	70.5	70.0	53.6
Renter occupied	29.5	30.0	46.4
Place of birth (%)			
State of residence	79.9	74.7	63.4
Different state, US territory, abroad to Am. parent	16.7	13.9	14.1
Foreign born	3.4	11.4	22.5
Veteran status among civilian population 18+ years (%)			
Veterans	9.7	7.4	5.4

Am.: American
FPL: federal poverty level

Health Behavior and Lifestyle Characteristics

The combined 2013-2014 and 2016 e-BRFSS data show that, in recent years, 65% of the population in Warren County was overweight or obese, and 30% was obese (Table 3-2). These values did not differ statistically from those for NYS excluding NYC. However, the pattern varied by sex. While the percentage of overweight or obese men in Warren County was statistically comparable to that for NYS excluding NYC, the percentage of overweight or obese women in

Table 3-2 Health Behavior and Lifestyle Indicators for Warren County and New York State excluding New York City, New York State Expanded Behavioral Risk Factor Surveillance System, 2013-2014 and 2016 Combined

Indicator	Warren County			NYS excl. NYC		
	Total N	Percent	SE (%)	Total N	Percent	SE (%)
Males and Females Combined						
Overweight or Obese	914	64.9	2.5	56,203	63.0	0.5
Obese	914	29.9	2.2	56,203	27.2	0.4
Current Smoker	941	20.9 *	1.8	58,182	16.7	0.4
Binge Drinker	928	17.1	1.6	57,032	16.9	0.4
Gets Leisure Time Physical Activity	971	78.4 *	1.8	59,519	74.2	0.4
Has Health Care Coverage [a]	633	91.6 *	1.5	38,567	88.3	0.4
Fully Met USPSTF CCSRs [b]	481	71.1	4.1	29,408	70.5	0.6
Males						
Overweight or Obese	455	67.2	4.0	25,278	70.3	0.7
Obese	455	27.0	2.8	25,278	28.4	0.6
Current Smoker	449	21.0	2.8	25,052	18.8	0.6
Binge Drinker	442	23.3	2.7	24,449	21.9	0.6
Gets Leisure Time Physical Activity	462	78.9	2.7	25,651	75.8	0.6
Has Health Care Coverage [a]	314	89.1	2.7	17,356	85.5	0.6
Fully Met USPSTF CCSRs [b]	220	67.2 ^	7.4	12,667	69.1	1.0
Females						
Overweight or Obese	459	62.5 *	3.1	30,924	55.4	0.7
Obese	459	32.9	3.4	30,924	25.9	0.6
Current Smoker	492	20.7 *	2.4	33,128	14.8	0.4
Binge Drinker	486	11.0	1.7	32,581	12.2	0.5
Gets Leisure Time Physical Activity	509	78.0 *	2.3	33,866	72.6	0.6
Has Health Care Coverage [a]	319	94.1	1.5	21,210	91.0	0.5
Fully Met USPSTF CCSRs [b]	261	74.9	3.3	16,741	71.7	0.8

[a] among 18-64 years old

[b] among 50-75 years old

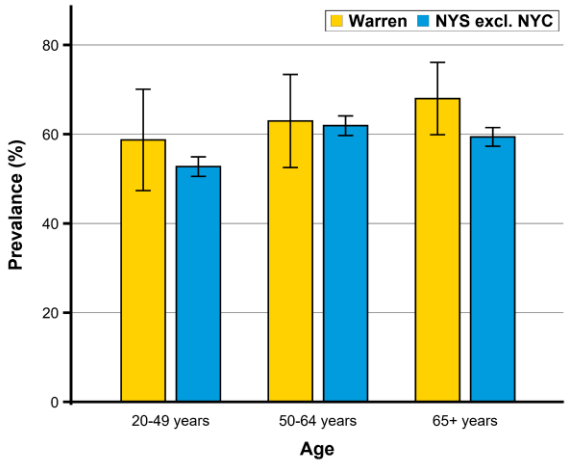
USPSTF CCSRs: US Preventive Services Task Force Colorectal Cancer Screening Recommendations

** significant at p<0.05 level for Wald chi-square test, Warren County compared to NYS excl. NYC*

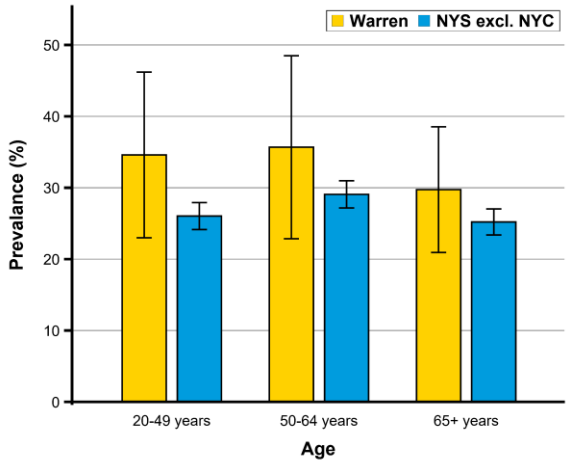
^ high-variability estimate (i.e., having confidence limits greater than ±10%)

Figure 3-2 Behavioral Risk Factors among Females by Age Group, Warren County and New York State excluding New York City: (A) Overweight or Obese; (B) Obese; (C) Current Smoker; and (D) Any Leisure Time Physical Activity, New York State Expanded Behavioral Risk Factor Surveillance System, 2013-2014 and 2016 Combined

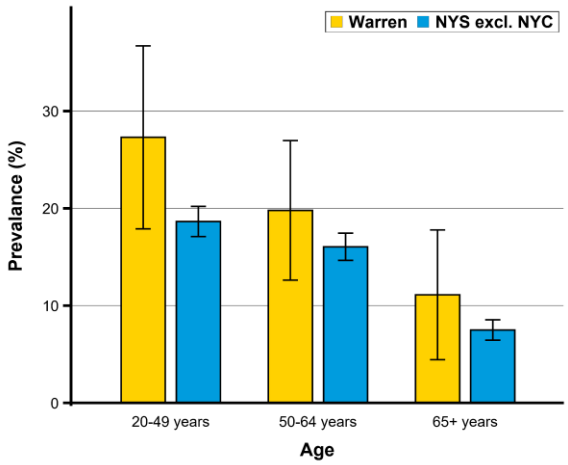
(A) Overweight or Obese



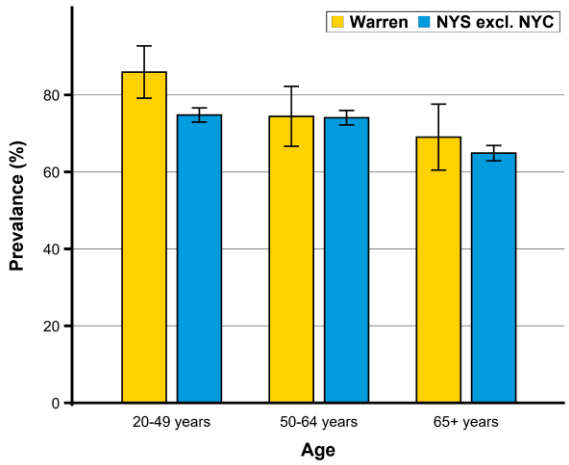
(B) Obese



(C) Current Smoker



(D) Any Leisure Time Physical Activity



Vertical lines represent the 95% confidence intervals.

Warren County was significantly higher than in NYS excluding NYC (62% versus 55%). The absolute difference of 7% in the percentage of obese women in Warren County compared to NYS excluding NYC (33% versus 26%) did not achieve statistical significance. Further evaluation by age indicated that for all three age groups the percentages of adult females that were overweight or obese, as well as obese, were higher for Warren County than for NYS excluding NYC (Fig. 3-2). However, none of the differences by age was statistically significant, although the difference in the prevalence of overweight or obesity among females 65 years of age or older (68% versus 59%) was borderline significant (p-value=0.051).

According to the e-BRFSS, 21% of the population (males and females combined) in Warren County were current smokers compared to 17% in NYS excluding NYC, a statistically significant difference (Table 3-2). Stratification by sex showed a significantly higher prevalence of current smokers among females but not among males. The prevalence of current smokers was higher in each age category among adult females in Warren County, although the differences with the comparison population were not statistically significant (Fig. 3-2).

The prevalence of binge drinking in Warren County, overall and by sex, did not differ statistically from the prevalence in NYS excluding NYC (Table 3-2).

Residents of Warren County (females in particular) were significantly more likely to engage in leisure time physical activity than those in NYS excluding NYC (Table 3-2). This difference was most pronounced among females aged 20-49 years (Fig. 3-2).

The percentage of adults 18 to 64 years of age estimated to have health care coverage was significantly higher for Warren County at 92% compared to NYS excluding NYC at 88%. However, the 4 and 3 percent differences for males and females, respectively, were not statistically significant.

According to the combined e-BRFSS, 71% of Warren County residents aged 50-75 years fully met the United States Preventive Services Task Force's (USPSTF) colorectal cancer screening recommendations (Table 3-2). There was no statistical difference in this metric between Warren County and NYS excluding NYC, either overall or when stratifying by sex.

The County Health Rankings & Roadmaps program takes into account multiple elements, such as adult smoking, adult obesity, food environmental index, physical inactivity, access to exercise opportunities, excessive drinking, alcohol-impaired driving deaths, sexually transmitted infections, and teen births when constructing its Health Behaviors measure. Between 2010 and 2016, Warren County was frequently ranked in the lower half among the 57 counties in NYS excluding NYC on the Health Behaviors measure (Table 3-3).

Table 3-3 Ranking of Warren County with Respect to Health Behaviors and Clinical Care among New York State (62 Counties) and New York State excluding New York City (57 Counties), the County Health Rankings & Roadmaps Program, 2010-2016

Year	Health Behaviors		Clinical Care	
	NYS	NYS excl. NYC	NYS	NYS excl. NYC
2010	30	26	12	11
2011	48	44	8	7
2012	42	38	3	3
2013	44	40	2	2
2014	46	42	2	2
2015	37	33	6	5
2016	14	12	1	1

Health Care System

Glens Falls Hospital and Hudson Headwaters Health Network (HHHN) are the two major providers of primary health care services in Warren County. The main campus of the Glens Falls Hospital has more than 400 beds. According to the 2013 Community Health Needs Assessment prepared by Glens Falls Hospital, the bed-to-population ratio of 622.8 per 100,000 persons for Warren County was more than twice the ratio for the Upstate New York region (276.3).[1] Both Glens Falls Hospital and HHHN operate multiple regional health care centers, and they also provide various community services and outreach to geographically remote communities across the county. In addition, Warren County has four nursing homes (with over 400 beds) and four adult care facilities (with over 240 beds).[1,2]

Using information on health care coverage, primary care providers, dentists, mental health providers, preventable hospital stays, diabetes monitoring, and mammography screening, the County Health Rankings & Roadmaps program placed Warren County in the top tier with respect to Clinical Care Factors among the 57 counties in NYS excluding NYC (Table 3-3).

Occupation and Industry

Historically, logging, mining, and the production of timber and wood products, particularly paper, were the key economic drivers in Warren County, reflecting the abundant natural resources of the North Country. Since the latter part of the 20th century, medical device development and manufacturing, financial services, healthcare, and information technology businesses have become new driving forces of economic growth, while recreation and tourism (e.g., in the Lake George Area) have remained important to the local economy.

To examine the potential for occupational exposure, data from the American Community Survey on the occupations of employed persons age 16 and over in Warren County and NYS excluding NYC were reviewed. Table 3-4 shows the occupational groups with a higher probability of workplace exposures to elevated levels of hazardous substances. Also included is the subcategory of “Service Occupations” that includes fire fighters, a group of special concern to the Warren County community. Approximately 22% of the civilian employed population 16 years of age and over in Warren County was engaged in an occupation associated with a higher probability of workplace exposures, which was slightly higher than the 20% in NYS excluding NYC. Finer groupings of occupations may be found in Appendix II, Table A-II-7. Among occupation groups listed in Table 3-4, the Warren County study area had somewhat more people working in construction and extraction occupations; production; transportation; and material moving (Table A-II-7). There were slightly fewer people working in installation, maintenance, & repair occupations. These percentages are based on small numbers of respondents, especially in the study area, and may not be meaningful.

Asbestos is a group of minerals that occur naturally in a fibrous form. Asbestos-related cancers include mesothelioma, lung, laryngeal, and ovarian cancers.[3] There is limited evidence for cancers of the stomach, pharynx, and colon. The primary routes of exposure to asbestos are

Table 3-4 Count (N) and Percent (%) of the Population in Selected Occupational Groups, Civilian Employed Population Age 16 and Over, Warren County and New York State excluding New York City, American Community Survey, 2011-2015[1]

Occupational Groups	Warren County		NYS excl. NYC	
	N	%	N	%
Natural resources, construction, and maintenance	2,656	8.3	431,817	8.1
Production, transportation, and material moving occupations	3,896	12.2	538,362	10.1
Fire fighting, prevention, and other protective service workers	440	1.4	69,149	1.3

[1] Complete data, including finer groupings of occupations, are presented in Table A-II-7 in Appendix II.

Table 3-5 Asbestosis Hospitalizations[1] in Warren County and New York State excluding New York City, New York State Statewide Planning and Research Cooperative System, 2001-2014[2]

Period	Warren County				NYS excl. NYC			
	Count	Rate[3]	LCI	UCI	Count	Rate[3]	LCI	UCI
2001-2005	14	3.6	2.0	6.1	4,320	7.0	6.8	7.3
2006-2010	32	7.5	5.1	10.7	4,607	7.2	6.9	7.4
2011-2014	20	5.5	3.3	8.7	3,210	5.8	5.6	6.0

[1] Hospital discharges with a primary or contributing diagnosis of Asbestosis: ICD-9-CM = '501'. For each patient, only the 1st asbestosis hospitalization in a specific period was included.
[2] ICD-10 diagnosis codes went into effect on and after October 1, 2014 and there was no one-to-one match for "501" in ICD-10.
[3] Rates are per 100,000 persons, age-adjusted to the 2000 U.S. standard population.

inhalation and ingestion. Occupations with a high risk of asbestos exposure include, but are not limited to, asbestos mining, construction workers, shipyard workers, manufacturing and industrial workers, automotive manufacturers and mechanics, firefighters, power plant workers, and textile mill workers. Asbestosis is a chronic disease caused by prolonged and intensive exposure to asbestos.

We used the asbestosis hospitalization rate as an indirect measure of potential past occupational exposure to asbestos. According to the NYS SPARCS database between 2011 and 2014 the hospitalization rate for asbestosis was 5.5 per 100,000 persons in Warren County, which was comparable to the 5.8 rate for NYS excluding NYC (Table 3-5). The rates in the 2006-2010 period were also comparable. The 2001-2005 asbestosis hospitalization rate for Warren County was significantly lower compared to that for NYS excluding NYC. Therefore, there is no evidence of elevated past exposure to asbestos in Warren County relative to NYS excluding NYC.

4. Environmental Data Review

Outdoor Air Pollution

Air Quality Monitored Data

NYS began developing air pollution control programs over 60 years ago with enactment of the nation's first comprehensive air pollution control laws in 1957 (Air Pollution Control Act, formerly Article 12-A of the Public Health Law). At the federal level, with the 1970 Clean Air Act, the EPA began regulating criteria air pollutants, which include carbon monoxide, nitrogen dioxide, sulfur dioxide, particulate matter, ozone, and lead, through the National Ambient Air Quality Standards (NAAQS) program. In 1990, the Clean Air Act was amended to include a list of HAPs selected by Congress based on potential health and environmental hazards. The original list included 188 HAPs such as benzene, which is found in gasoline; tetrachloroethene (PERC), which is emitted from dry cleaning facilities; methylene chloride, which is used as a solvent and paint stripper; and some metals such as cadmium, mercury, and chromium.

The EPA's AQS database contains data from air quality monitoring stations across NYS at various locations and timeframes since 1965. This database currently includes sulfur dioxide, ozone, carbon monoxide, nitrogen dioxide, lead, total suspended particulates, and particulate matter less than 2.5 and 10 microns ($PM_{2.5}$ & PM_{10}) in diameter. Although toxicological data do not indicate that these criteria air pollutants are environmental risk factors for cancer, they were evaluated since they provide the longest historical measurements of air pollution.

Criteria air pollutants were monitored in Warren County (Glens Falls) starting in 1973 for nitrogen oxide and sulfur dioxide. In 1990, a particulate matter (<10 microns, PM_{10}) monitor was installed. The long-term trends can be found in Appendix II, Figure A-II-1. Sulfur dioxide pollutant concentrations have decreased substantially over time and the historical monitoring concentrations for nitrogen dioxide and PM_{10} were low throughout the monitoring period. Results for Warren County demonstrated compliance with all NAAQS requirements and the monitor was closed in 1996. Currently, there are no criteria air pollutant monitors in Warren County. The primary NAAQS are health-based, but the levels are not specifically based on the risk of developing cancer. The statewide air toxics network was established in 1990, but there is no current or historical air toxics monitoring information for Warren County.

Modeled Data: NATA Data

For the NATA program**,** the EPA developed a complex dispersion model that merges the emissions data with meteorological data, such as wind speed and wind direction, to estimate pollutant concentrations in ambient air. The emissions data used to model air pollutant levels come from state sources, the Toxic Release Inventory, the National Emissions Inventory, and other databases. This program accounts for emissions from large industrial facilities, such as power plants and manufacturing facilities; smaller facilities, such as dry cleaners and gas stations; mobile sources such as motor vehicles, trains, planes/airports, ports and boats; and

farming and construction equipment. It also accounts for secondary formation of pollutants through photochemical mechanisms and pollution due to residential wood burning, wildfires, agricultural burning, and structural fires. NATA calculates concentrations by using a single year's emissions data and estimates health risk from breathing these air pollutants over a lifetime (or approximately 70 years). The cancer risk estimate is a theoretical estimate and does not estimate the risk for any individual or group of people. It should be noted that a direct comparison of the cancer risk estimates from different NATA years needs to be interpreted with caution due to changes in the air modeling and emissions inventory. The number of EPA-designated HAPs included in the model has varied from 32 in 1996 to 180 plus diesel particulate matter in 2014.

The emissions data used for the 2011 and 2014 NATA are the most comprehensive. Therefore, DOH researchers used the NATA modeled estimates from the 2011 and 2014 emission inventory years to evaluate whether cancer risk, based on exposures to EPA-designated HAPs, in the study area (Warren County) was unusual as compared to other areas of New York State. The comparison area used was the average for NYS excluding NYC, or NYS. All HAPs that are known or probable carcinogens according to agencies such as IACR, EPA, and NTP were initially screened to determine which pollutants were estimated to have more than a one-in-one-million cancer risk. A one-in-one-million cancer risk level is so small that it would not be detected in an epidemiologic study. Because many of the HAPs have low modeled concentrations and small cancer risks, this resulted in selection of only five pollutants: 1,3-butadiene, acetaldehyde, benzene, carbon tetrachloride and formaldehyde. High levels of exposure to 1,3-butadiene over a long period of time may increase the risk for cancers of the blood and lymphatic system in humans.[1] The cancer caused by long-term inhalation exposure to high-level benzene is predominantly leukemia, especially acute nonlymphocytic (myelocytic) leukemia.[2] In addition, animal studies have demonstrated an increased incidence of nasal and laryngeal tumors from acetaldehyde,[3] liver tumors from carbon tetrachloride,[4] and respiratory tract tumors from formaldehyde.[5] Appendix V presents additional information on these five pollutants.

Next, a ratio comparing the cancer risk estimate for the study area to the cancer risk estimate for each comparison area was calculated for each of the five HAPs. A ratio greater than one indicates the estimated cancer risk was higher in the study area than in the comparison area. It should be noted that an increase in exposure to either a trace amount of an air pollutant or a pollutant with very low carcinogenic risk, is unlikely to elicit an increase in adverse health effects that can be detected epidemiologically.

Table 4-1 shows the risk estimates and the comparison ratios for the five HAPs included in the evaluation for NATA 2011. Table 4-2 shows the same information for NATA 2014. For each of these five HAPs, the estimated cancer risk due to inhalation is either similar or lower in Warren County relative to NYS excluding NYC and to NYS.

Table 4-1 Comparison Ratios and Risk Estimates for EPA-designated Hazardous Air Pollutants, NATA 2011

List of HAPs	Comparison Ratios		Total Cancer Risk (per million)		
	Warren County vs. NYS excl. NYC	Warren County vs. NYS	Warren County	NYS excl. NYC	NYS
1,3-Butadiene	0.73	0.41	1.43	1.96	3.51
Acetaldehyde	0.93	0.74	3.09	3.31	4.20
Benzene	0.93	0.63	5.38	5.81	8.47
Carbon Tetrachloride	1.00	1.00	3.28	3.28	3.28
Formaldehyde	0.92	0.69	14.12	15.26	20.51

Table 4-2 Comparison Ratios and Risk Estimates for EPA-designated Hazardous Air Pollutants, NATA 2014

List of HAPs	Comparison Ratios		Total Cancer Risk (per million)		
	Warren County vs. NYS excl. NYC	Warren County vs. NYS	Warren County	NYS excl. NYC	NYS
1,3-Butadiene	0.67	0.35	0.64	0.95	1.85
Acetaldehyde	1.10	0.91	1.91	1.75	2.11
Benzene	0.87	0.62	3.06	3.52	4.96
Carbon Tetrachloride	1.00	0.99	3.26	3.28	3.29
Formaldehyde	1.00	0.80	12.50	12.49	15.55

The Hudson River Communities Project

Special studies provide a snapshot in time of current air quality at the local level at the time of the study. DOH researchers are aware of one special air monitoring study conducted as part of the Hudson River Communities Project, a DOH environmental health study in Fort Edward, Hudson Falls and Glens Falls. Glens Falls is the only community which is within the Warren County study area since Fort Edward and Hudson Falls are located in Washington County. The purpose of this study was to look at how polychlorinated biphenyls (PCBs) affect people's nervous systems. As part of this study, over 250 outdoor air samples were collected between the years 2000 and 2002 in the study areas (Fort Edward and Hudson Falls) and the comparison area (Glens Falls). The study found that PCB levels in the study area (Fort Edward and Hudson Falls) were somewhat higher than levels in the comparison area (Glens Falls). The air collected outdoors at the homes in the study area had an average level of 0.72 nanograms per cubic meter (ng/m^3) of air compared to 0.40 ng/m^3 in the comparison area. However, the average outdoor air PCB levels measured in this project for both groups (0.40 and 0.72 ng/m^3) are low and within the range of levels reported for other research projects done in the United States where there were no unusual sources of PCBs (ranging from 0.40 to 3.6 ng/m^3).

Residential Wood Combustion

Although all regions of NYS comply with the current EPA National Ambient Air Quality Standards for fine particulates (i.e., $PM_{2.5}$), scientists have identified that residential wood combustion in NYS is an important source of fine particulates or soot in outdoor air. For rural counties, residential wood combustion is responsible for almost all (>90%) of carbonaceous $PM_{2.5}$ emissions.[6,7]

Wood smoke is a complex mixture of particulates, aerosols, carbon monoxide, polycyclic aromatic hydrocarbons, benzene, aldehydes, nitrogen oxides and free radicals.[8] Emissions from wood burning appliances can vary significantly in amount of wood smoke produced and its composition depending on the temperature of the wood fire, the technology employed in the appliance and the quality of the wood fuel. The EPA states that the biggest health risk from wood smoke is associated with fine particles which can irritate the eyes and respiratory system, cause bronchitis and worsen or trigger asthma attacks and may also trigger heart attacks, stroke, irregular heart rhythms, and heart failure in "at-risk" populations. In 2010, the World Health Organization's International Agency for Research on Cancer (IARC) concluded that indoor emissions from household combustion of biomass fuel (mainly wood) are probably carcinogenic based on limited evidence in humans (lung cancer) exposed to very high levels of wood smoke while cooking indoors and experimental animals (lung adenocarcinomas), evidence of carcinogenicity of wood smoke extracts in experimental animals, and its mutagenic properties.[9,10]

For the 2011 emissions inventory year used for NATA, the EPA estimated that residential wood combustion contributed 13% to the county's average inhalation cancer risk. The percentage contributions to overall risk for individual census tracts in Warren County range from 5 to 16. For the 2014 inventory year, the EPA estimated that residential wood combustion contributed 11% of Warren County's average inhalation cancer risk; where the percent contributions for Warren County census tracts ranged from 1.5 to 16. It should be noted that the NATA model may not adequately represent actual neighborhood exposure given the variability in wood heating locations, the amount of wood burned, emission profiles for each wood-burning appliance, and the impacts of terrain on smoke dispersion.

Residents can reduce their wood smoke exposures and potential health risks by burning clean, dry, seasoned firewood in modern, efficient EPA-certified wood burning appliances with stacks that extend beyond the roofline. NYS Energy Research and Development Authority currently operates an incentive program to "change-out" older, more polluting wood burning devices for cleaner, efficient appliances (see "Renewable Heat NY" at https://www.nyserda.ny.gov/All-Programs/Programs/Renewable-Heat-NY).

Summary

Since the enactment of Federal and State regulatory actions under the Clean Air Act and its Amendments, air quality has improved significantly. The criteria pollutant monitor in Warren

County showed that outdoor air met national air quality standards and it was closed in 1996. The evaluation of the NATA estimates of inhalation cancer risks did not reveal any unusual exposures for this study area. DOH researchers estimate that inhalation exposure to the levels of these listed chemicals in the outdoor air poses a low risk of cancer. This review indicates that Warren County residents as a group are not experiencing unusual inhalation exposures. Therefore, available data on outdoor air do not indicate an unusual impact of air pollution on cancer incidence in Warren County in recent years.

Limitations

There are a variety of limitations to this type of group-level analysis of outdoor air quality. Three important limitations are described here: (1) This type of evaluation is unable to fully characterize people's individual inhalation exposures to chemicals inhaled due to specific behaviors (including smoking), use of consumer products, occupational exposures, and hobbies. (2) DOH and DEC researchers do not have access to comprehensive data for historical outdoor air concentrations for hazardous air pollutants. This means the timeframe covered by the data used to characterize outdoor air quality for this review does not match the relevant historical timeframe for exposures potentially related to cancer, given the long latency period for most types of cancer. (3) For this region, residential wood burning may be a significant source of air pollution, particularly in winter months. Although NATA does include emissions from this source category in its model, the modeling for this type of source may not adequately characterize impacts that occur only in very close proximity to a wood-burning source.

Radon in Indoor Air

Test Results

From 1987 to 2015, there were 153,765 valid tests (values at or above the laboratory's lowest detection level of 0.17 pCi/L) conducted in homes and schools across NYS. The statewide average radon test value was observed at 5.53 pCi/L with 64% of the tests performed in the basement, 32% in the first floor living area and 4% in other or unknown floors.

For the most accurate reading of radon levels in a home, tests are conducted in the lowest living space, which is generally the basement or first floor of the building. Results in this report reflect values of 131,914 radon tests conducted in basements and first floors across NYS (excluding tests performed at schools and day care centers) (Table 4-3). About a third of these tests had values at or exceeding the action level of 4 pCi/L. Two thirds of the tests were conducted in the basement where radon test levels averaged at 6.96 pCi/L with a maximum of 601.4 pCi/L. Statewide radon values for first floor tests averaged at 3.81 pCi/L with a maximum value of 259.5 pCi/L. In general, radon levels across NYS excluding NYC were slightly higher than NYS.

A total of 454 tests were conducted across Warren County from 1987 through 2015, with an average radon level of 3.22 pCi/L (range 0.2 to 90.1) (Fig. 4-1 & Table 4-3). About 71% of tests in

Figure 4-1 Radon Concentrations Measured in Warren County

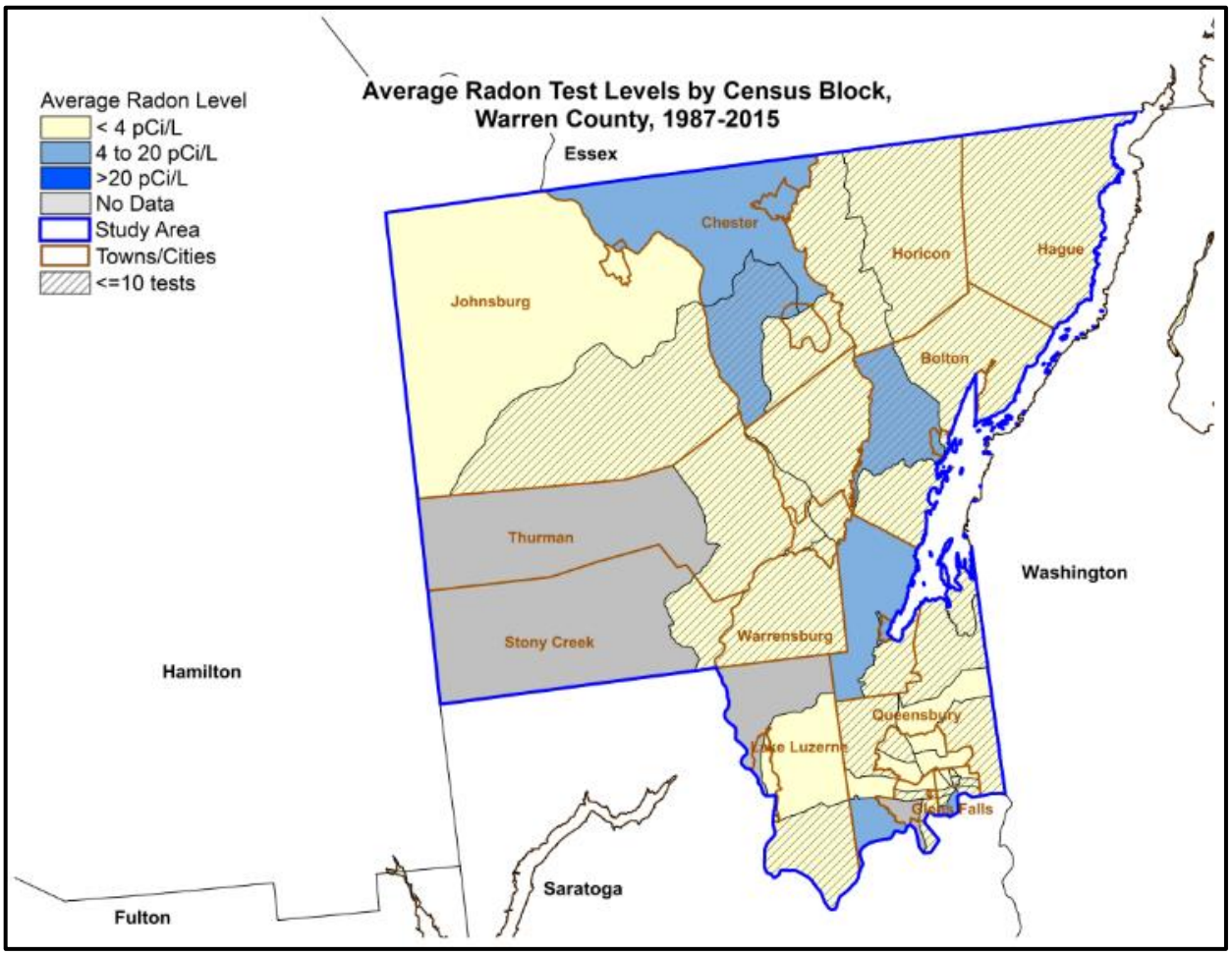


Table 4-3 Summary of Radon Tests* in Warren County, New York State Excluding New York City, and New York State from 1987 to 2015

Area	Mean Concentration (pCi/L)			Max Conc. (pCi/L)	% test results ≥ 4 pCi/L
	All floors (N)	Basement (N)	First Floor (N)		
Warren County	3.22 (454)	3.56 (320)	2.40 (134)	90.1	16.74
NYS excl. NYC	6.70 (129,645)	7.06 (89,701)	3.85 (39,944)	601.4	34.30
NYS	5.99 (131,914)	6.96 (91,440)	3.81 (40,474)	601.4	33.83

** excluding tests performed at schools and day care centers*

Warren County were conducted in the basement and showed an average radon value of 3.56 pCi/L (maximum value 90.1); first floor test values averaged 2.40 pCi/L (maximum value 44.8). About 17% of tests in Warren County had values at or higher than the EPA action level. Average radon levels in Warren County (overall, basement and first floor levels) were lower than statewide radon levels as well as the levels in NYS excluding NYC.

Summary

Based on test results in the database, it appears that radon is not be a significant environmental exposure in Warren County. Radon tests levels were observed to be generally lower than statewide results.

Limitations

Since results can vary from home to home, values of radon in tested homes do not represent other homes in the neighborhood. The DOH therefore recommends that all residents have their homes tested to obtain actual radon levels for their homes.

Drinking Water Quality

Public Water Systems

Warren County has 31 active public water systems and 6 inactive systems. Staff reviewed data for all these systems. Of the 31 active public water systems, 25 are community sources serving approximately fifty-one thousand residents with daily water, and six are non-transient non-community systems such as a school or business (Table 4-4). Warren County has a relatively low population density, with a total population of around sixty-five thousand (2011-2015 American Community Survey). Although public water systems supply about 80 percent of the County's population, private water sources serve residents in rural areas. Analyte testing data for private wells were not available for review.

Analytes Measured

Monitoring of drinking water quality in Warren County follows DOH and federal government requirements. Based on their properties, analytes monitored in drinking water samples were grouped into seven categories: Principal Organic Compounds (POCs), Nitrates (NITs), Primary Inorganic Compounds (PICs), Synthetic Organic Compounds (SOCs), Radiological Samples (RADS), Disinfection Byproducts (DBPs), and Lead and Copper (PBCU). A full list of analytes in these groupings that were reviewed in this study can be found in Appendix IV, Tables A-IV-1 to A-IV-7.

Violations

Public water systems are required to routinely test for contaminants in drinking water. If sampling reveals an exceedance of a maximum contaminant level (MCL), a violation is issued. The public water system is required to make public notification and to take steps to reduce the

Table 4-4 List of Public Water Systems and Counts of Population Served in Warren County

Community	Count	Non-Transient Non-Community	Count
Adirondack Lodges - Adirondack	150	Club Grill at The Sagamore	43
Antlers at Diamond Point	125	Creative Stage Lighting Co. Inc.	35
Arcady Bay Estates	470	Double H Hole in The Woods	225
Balsam Crest Homeowners Assoc.	50	Gore Mt Ski Area	180
Bolton Water District	1,800	Silver Bay Association	1,000
Cannon Point Condominiums	275	Word of Life Bible Institute/Ranch	510
Chestertown Water District	750	Creative Stage Lighting*	61
Diamond Point Water District	493	Pirate Island Daycare*	50
Evergreen Homeowners Assoc.	56	Ross, E. Wendell*	110
Glens Falls City	14,000		
Gore Village at North Creek	48		
Green Harbour Development	100		
Green Mansions HOA Tennis & Swim	180		
Hudson River Trailer Park	22		
K & J Adirondack Properties LLC	45		
Lagoon Manor Homeowners Assoc.	180		
Lake George Village	1,800		
Lake Luzerne Water District	2,500		
Ledgeview Village M.H.P.	330		
North Creek Water District	1,100		
Pottersville Water District	300		
Queensbury Water District	21,200		
Rogers Cottages & Condominiums	45		
Top of The World	132		
Warrensburg Water District	4,100		
Fourth Lake Water District (Lake Luzerne)*	250		
Moose Hollow Apartments*	36		
Sherman Ave. Water District (Queensbury)*	160		

** indicates an inactive Public Water System*

contaminant level below the MCL. For this cancer investigation, staff reviewed testing results for analytes that were detected at levels higher than the respective MCLs and focused primarily on the subset of tests that led to violations being issued. There were seven MCL violations issued in Warren County for a class of compounds known as disinfection byproducts. The water systems with these violations were the Glens Falls City system and the Lagoon Manor Homeowners Association system in Bolton. More details about these violations are provided below.

In 2003, concentrations of Total Trihalomethanes (TTHMs), which are disinfection by-products, led to the issuance of five MCL violations for the Glens Falls City system (Table 4-5). The levels resulting in violations ranged from 0.093 mg/L to 0.124 mg/L compared to the MCL of 0.08 mg/L. In 2009, concentrations of Total Trihalomethanes (TTHMs) and Total Haloacetic Acids (HAA5), which are also disinfection by-products, resulted in violations at the Lagoon Manor Homeowners Association. For both analytes, the exceedance levels were slightly above the MCL. For total haloacetic acids, the level that was in violation was 0.063 mg/L compared to the MCL of 0.06 mg/L. For total trihalomethanes, the level resulting in a violation was 0.084 mg/L compared to the MCL of 0.08 mg/L.

Table 4-5 Maximum Contaminant Level Violations Relating to Average Analyte Levels among the Public Water Systems in Warren County

PWS Name	Violation Type	Analyte	Exceedance (mg/L)	Limit (mg/L)	Date*
Lagoon Manor Homeowners Assoc.					
	Average	Total Haloacetic Acids (HAA5)	0.063	0.06	02/02/09
	Average	Total Trihalomethanes (TTHM)	0.084	0.08	02/02/09
Glens Falls City					
	Average	Total Trihalomethanes (TTHM)	0.113	0.08	04/29/03
	Average	Total Trihalomethanes (TTHM)	0.124	0.08	04/29/03
	Average	Total Trihalomethanes (TTHM)	0.121	0.08	04/29/03
	Average	Total Trihalomethanes (TTHM)	0.093	0.08	07/08/03
	Average	Total Trihalomethanes (TTHM)	0.118	0.08	07/08/03

** This is the determination date when the local health department recorded the violation.*

Many studies have evaluated the possible health risks from drinking water containing disinfection by products. Some of these studies suggest that people who drank water containing disinfection byproducts (including TTHMs and HAA5) for long periods of time (e.g., 20 to 30 years) have an increased risk for cancer. However, the methods used in these studies could not rule out the role of other factors that could have resulted in the observed increased risks, and not all studies have shown an increased risk for cancer. Therefore, the overall evidence from the studies is not strong enough to conclude that trihalomethanes were a major factor contributing to the observed increases in cancer risk. Studies of laboratory animals show that certain disinfection byproducts can cause cancer, but at exposures much higher than exposures that could result through normal use of drinking water. The epidemiological studies of exposure to TTHMs suggest an association specifically with bladder cancer.[11] Rates of bladder cancer in Warren County are not elevated.

The EPA reviewed the human and animal studies and concluded that, while available data are inadequate to demonstrate a causal link between disinfection byproducts (including TTHMs and HAA5) and cancer, the observed associations between disinfection byproducts and cancer warrant strong regulations that limit the amount of disinfection byproducts in drinking water

but still allow for adequate disinfection.[12,13] The risks for cancer from disinfection byproducts in drinking water are small compared to the risks for illness from drinking inadequately disinfected water.

For analytes with MCLs based on aesthetic properties such as taste and color, there were 11 violations in Warren County. One of these 11 violations was issued to K & J Adirondack Properties LLC for chloride in January 2018. Ten such violations on various dates from 2008, 2009, 2010 and 2014 were issued to the Warrensburg Water District, with nine violations for iron (Fe) and one for color. The EPA's "secondary" MCL for iron at 0.3 mg/L represents the concentration at which iron will stain clothing and dishes but is not related to health risk. Iron has not been shown to be carcinogenic, even at toxic levels.[14]

DOH district and regional offices and local health departments monitor water quality on a day-to-day basis. When a public water system receives an MCL violation, the public receiving that water must be made aware, and the water supply must take corrective actions required by the EPA or NYS to return to compliance. Health risks are described in language provided in notification letters to households served by the water supply. The health risks are determined by analyte type, concentration level, and amount of exposure based on guidelines established by the EPA and other authoritative bodies.

Unregulated Contaminants

EPA's Unregulated Contaminant Monitoring Rule (UCMR) collects occurrence data for contaminants that do not have health-based standards set under the Safe Drinking Water Act but may be present in drinking water. The monitoring consists of no more than 30 contaminants every five years and is collected from all large public water systems (> 10,000 people) and a representative sample of small public water systems. The data collected help to inform future regulatory determinations.

EPA's Third Unregulated Contaminant Monitoring Rule (UCMR 3) occurred between 2013 and 2015. The list of UCMR 3 contaminants can be found in Appendix IV, Tables A-IV-8. The UCMR 3 contaminants detected in Warren County public water systems were all below EPA reference levels provided in EPA's UCMR 3: Data Summary, January 2017.[15] EPA's reference concentrations provide context but do not represent an "action level". They are health guidelines estimated from animal studies with a level of uncertainty built in.

Summary

The public water systems in Warren County serve approximately 80% of its residences. Overall, they have met safe drinking water standards and are consistently in compliance, with very few instances of MCL exceedances. Although some violations occurred for specific public water systems, it is highly unlikely that this drinking water exposure increased the cancer burden to the Warren County population.

Limitations

Data utilized for this review were collected for routine monitoring. These data were not collected for the purpose of assessing potential links between cancer rates and drinking water. One key limitation associated with use of these data to indicate human exposures in the study area is the use of privately sourced water. Warren County is predominantly rural and therefore has a substantial proportion of the population relying on private water sources. Private well data were not available for review as part of this evaluation.

Industrial and Inactive Hazardous Waste Disposal Sites

A total of 22 industrial and inactive hazardous waste disposal sites were identified in Warren County, including sites about which residents voiced concern. Information on the status of each site can be found in Appendix II, Table A-II-8. In some cases, on-site contamination exists but is not causing off-site exposure. For other sites, information continues to be gathered. For many sites, actions to identify, control, and/or remove existing contamination have been implemented and completed. Overall, based on a review of available data, there is no information suggesting that contamination from existing and known remedial sites is causing widespread exposures in Warren County.

Other Environmental Concerns – Traffic Density

The 2015 average annual daily traffic (AADT) volume for Warren County is illustrated in Figure 4-3. The most heavily trafficked road is Interstate 87, which runs north-south roughly through the middle of Warren County.

Staff looked at the proportion of people who live within 500 meters of roads with traffic density information. Given the relatively rural geography of Warren County, the appropriate comparison in terms of traffic would be NYS excluding NYC. Compared to NYS excluding NYC, Warren County has zero percent of people that live within 500 meters of roads with an AADT volume of 75,000-300,000 vehicles, and a lower proportion of people living within 500 meters of roads with an AADT volume of 25,000 to 74,999 vehicles (Table 4-6). Warren County also had a smaller proportion of its population living near heavily trafficked road than NYS as a whole.

NATA also incorporates mobile sources (i.e., traffic) in its modeled estimates of air toxics. Therefore, the contribution of traffic is also accounted for in the outdoor air quality results. Broadly speaking, the NATA results are consistent with these traffic density results (see Outdoor Air Quality).

Figure 4-3 Map of Traffic Density for Warren County, 2015

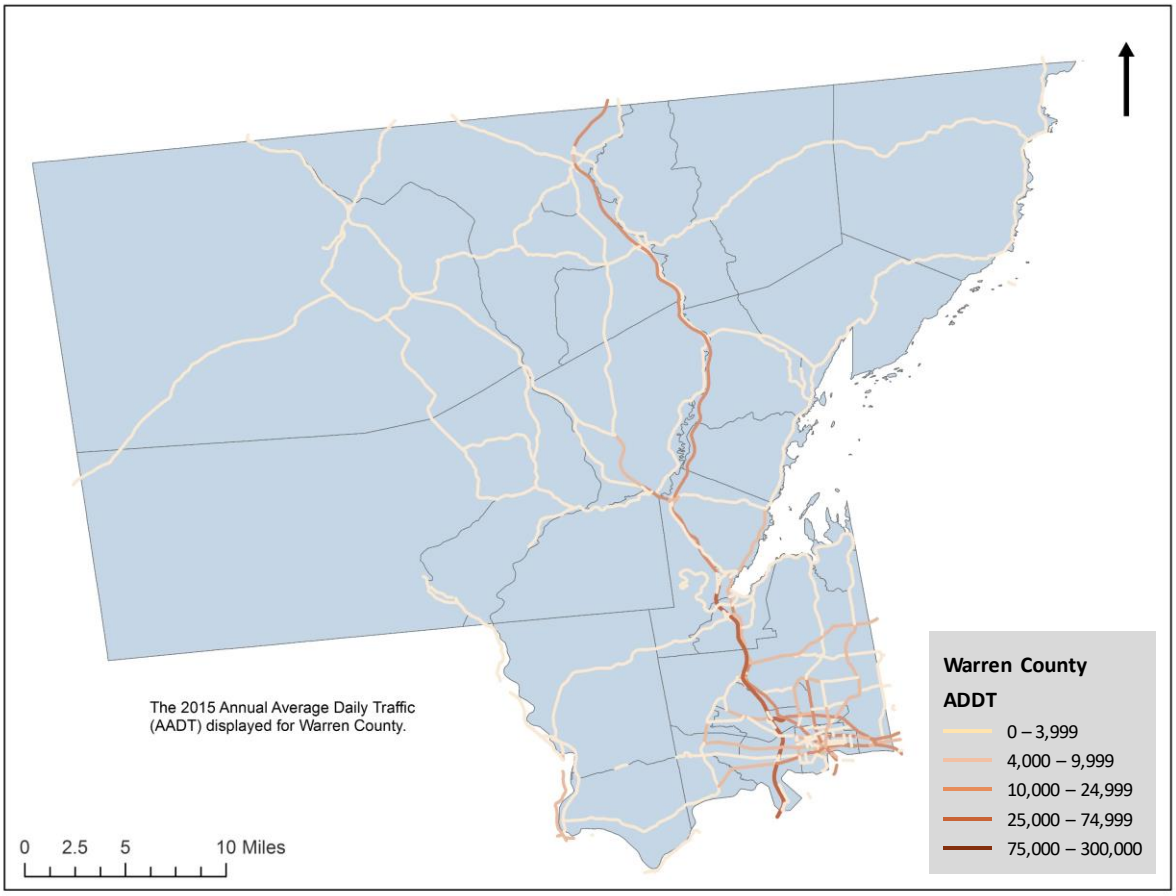


Table 4-6 Percent Population Living within 500 m of DOT Monitored Roads by Average Annual Daily Traffic Volume, 2015

Area	AADT Volume (1,000 vehicles)		
	75 - 300	25 - <75	<25
Warren County	0%	6%	94%
NYS excl. NYC	5%	14%	81%
NYS	15%	21%	64%

Environmental Factors Summary

In summary, available data on environmental factors, including environmental contaminants in outdoor air, levels of radon in indoor air, contaminants in drinking water, industrial and inactive hazardous waste disposal sites, and traffic density, were evaluated. While these data do not comprise an exhaustive review of all potential environmental exposures, they do provide

information about how Warren County exposures compare to those in the rest of NYS. The available data that were reviewed do not show evidence of unusual exposures in Warren County.

5. Oral Cancer

Overview

Oral cancer is a general term, encompassing cancers of the mouth and throat, including the lips and salivary glands. Frequently the terms oral cavity and pharynx are used in place of mouth and throat. In the Surveillance, Epidemiology, and End Results (SEER) statistics, oral cancer also includes cancer of the nasopharynx, the part of the throat that connects the nose and mouth. Oral cancer most commonly occurs on the tongue, gums, salivary glands, tonsils and the oropharynx (the part of the throat just behind the mouth). The American Cancer Society estimates 51,540 new cases of oral cancer in the United States in 2018, with 72% in males and 28% in females.[1]

Risk Factors

Oral cancer is associated with all forms of tobacco use, including cigarette and pipe smoking, snuff, and chewing tobacco.[2] Alcohol consumption is another important risk factor for oral cancer. Persons who consume five or more drinks per day have a five to six times greater risk compared to those who abstain.[3] The greatest risk is among people who are heavy users of both tobacco and alcohol.[4] Infection with the human papillomavirus (HPV), particularly the HPV-16 subtype, is another cause of oral cancer.[5] As with many cancers, a positive family history is a risk factor.[6] In terms of risk factors for specific oral cancers, cancer of the lip has been associated with exposure to sunlight,[7] and cancer of the salivary glands has been associated with exposure to ionizing radiation.[8] Although rare in the United States, the chewing of betel quid and gutka, which is common in India and China, increases the risk of cancer of the oral cavity.[9] Nasopharyngeal cancer is related to infection with the Epstein Barr Virus (EBV), especially in parts of the world where EBV infection is very common,[10] and occupational exposures such as formaldehyde and wood dust have been associated with cancer of the nasopharynx.[11] Persons whose diets include large amounts of fruits and vegetables are at lower risk of oral cancers, suggesting that nutrients from these foods may be protective.[12]

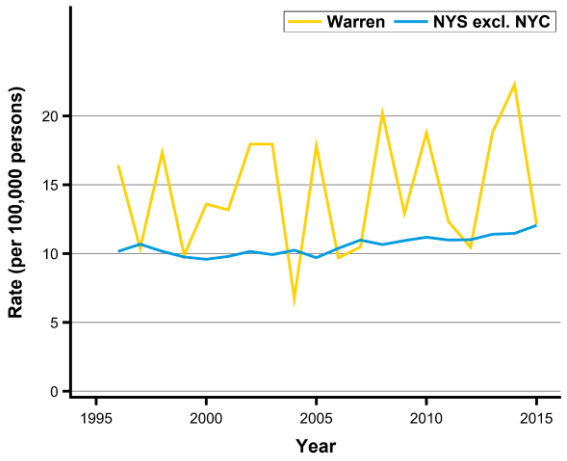
Findings

Annual case counts of oral cancer for Warren County during 1996-2015 ranged from five to twenty, so the incidence rate varied considerably from year to year (Fig. 5-1(A)). In comparison, the incidence rate for NYS excluding NYC increased gradually by about 1.4% per year between 2001 and 2015, and was generally below the rate for Warren County. For each of the four 5-year periods examined, the rate in Warren County was at least 33% above the rate for NYS excluding NYC and was statistically significantly higher in the latest three periods (Fig. 5-1(B)).

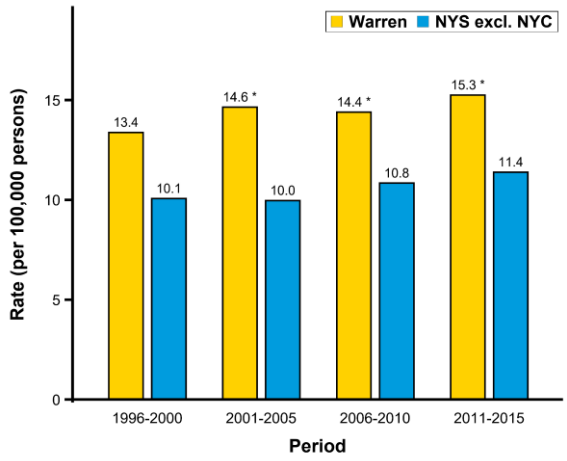
The incidence rate was higher in men than in women for both Warren County and NYS excluding NYC, with a male-to-female ratio of approximately 2.5 to 1 (Fig. 5-2). For both males

Figure 5-1 Oral Cancer Incidence Rates[1] for Warren County and New York State excluding New York City, 1996-2015

(A) Annual Rates



(B) 5-year Average Rates

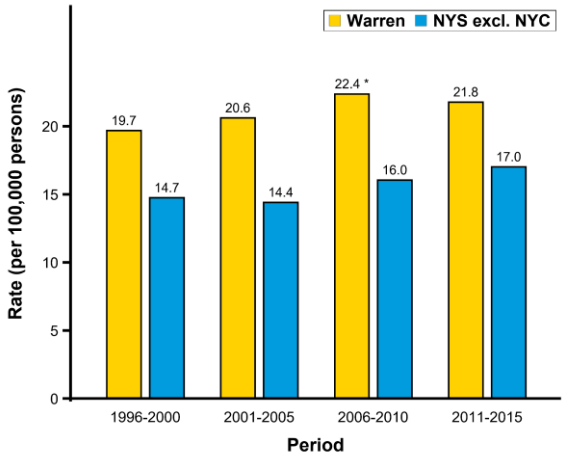


[1] *Incidence rate was age-adjusted to the 2000 US standard population.*

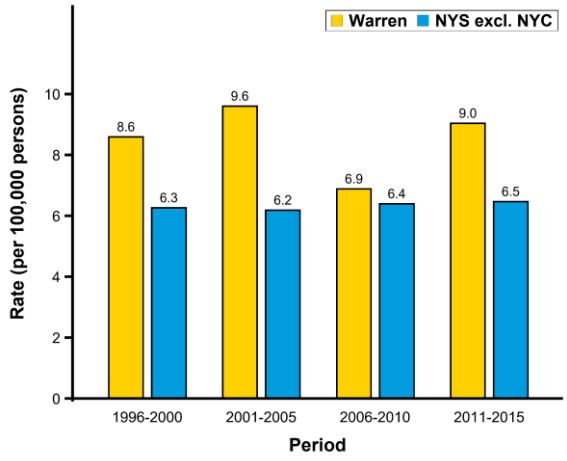
[*] *The rate for Warren County is statistically different from the rate for NYS excl. NYC at p<0.05 level.*

Figure 5-2 Oral Cancer Incidence Rates[1] by Sex and Time Period, Warren County and New York State excluding New York City, 1996-2015

(A) Male



(B) Female



[1] *Incidence rate was age-adjusted to the 2000 US standard population.*

** The rate for Warren County is statistically different from the rate for NYS excl. NYC at p<0.05 level.*

and females, oral cancer incidence was higher in Warren County than in NYS excluding NYC during each 5-year period. Likely due to the small numbers of cases, the excesses were not statistically significant except among males in the 2006-2010 period. During 2011 to 2015, the incidence rates for Warren County were 28% higher in males (21.8 versus 17.0 per 100,000 persons) and 40% higher in females (9.0 versus 6.5) compared to the rates for NYS excluding NYC. Approximately 60% of the overall excess was attributable to males.

Table 5-1 shows oral cancer incidence for 2011 to 2015 by sex and age. Most of the excess occurred among individuals aged 50-64. In this age group, the Warren County incidence rate was higher than the rate for NYS excluding NYC by 65% and 95% for males and females, respectively. However, the elevation was only statistically significant among males.

The incidence rates of oral cancer diagnosed at regional stage were significantly higher for both males (by 57%) and females (by 140%) in Warren County between 2011 and 2015 (Fig. 5-3), compared to the rates for NYS excluding NYC. There was also a 46% elevation in the local-stage incidence rate among males in Warren County, compared to the reference population (6.9 versus 4.7 per 100,1000 persons). However, this difference was not statistically significant. For

Table 5-1 Oral Cancer Incidence Rates[1] by Sex and Age Group, Warren County and New York State excluding New York City, 2011-2015

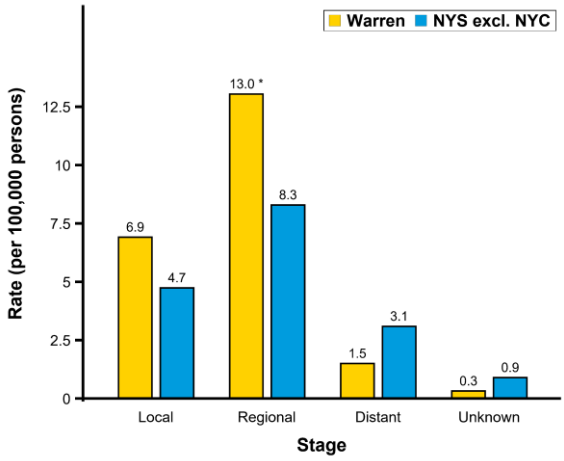
Age Group (years)	Male & Female		Male		Female	
	Warren County	NYS excl. NYC	Warren County	NYS excl. NYC	Warren County	NYS excl. NYC
≤19	0.0	0.2	0.0	0.1	0.0	0.3
20-49	5.4	4.3	9.6	6.0	1.3	2.6
50-64	46.3 *	27.5	67.6 *	42.3	25.9	13.3
65+	47.2	42.2	59.0	63.2	36.2	25.8

[1] Incidence rate was age-adjusted to the 2000 US standard population.

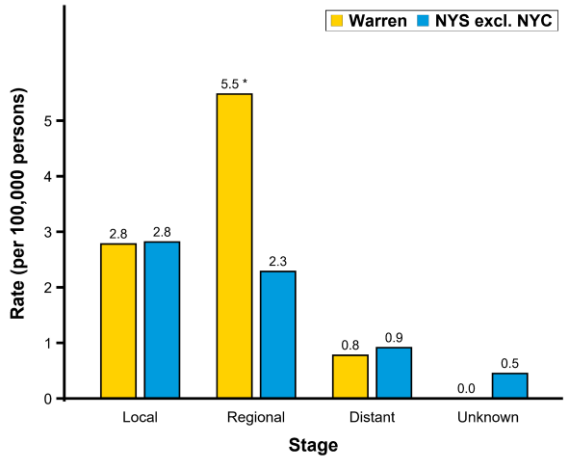
** The rate for Warren County is statistically different from the rate for NYS excl. NYC at p<0.05 level.*

Figure 5-3 Oral Cancer Incidence Rates[1] by Sex and Stage at Diagnosis, Warren County and New York State excluding New York City, 1996-2015

(A) Male



(B) Female



[1] Incidence rate was age-adjusted to the 2000 US standard population.

** The rate for Warren County is statistically different from the rate for NYS excl. NYC at p<0.05 level.*

both sexes combined, regional-stage tumors account for most of the excess in Warren County compared to NYS excluding NYC.

From 2011 to 2015, 96% and 85% of the oral cancer cases diagnosed in Warren County and NYS excluding NYC, respectively, were reported as squamous cell carcinomas, and about 1% and 4% were adenocarcinomas. The remaining 3% and 11% were other carcinomas, sarcomas, and cancers with unspecified cell type. The incidence of squamous cell carcinoma in Warren County was significantly higher than in NYS excluding NYC by 51% (14.5 versus 9.6 per 100,000 persons).

The distribution of oral cancer cases in Warren County by reported tobacco use, overall and by sex, is presented in Table 5-2. About 58% of oral cancer cases were reported to the NYSCR as either current or former tobacco users.

Squamous cell carcinomas occurring at specific subsites of the oral cavity and pharynx (e.g., base of tongue, tonsil) are considered to be HPV-associated.[13] About 57% of oral squamous cell carcinomas diagnosed among residents of Warren County between 2011 and 2015 arose in subsites considered to be HPV-related, compared with 49% in NYS excluding NYC. The incidence rate of HPV-associated oral cancers in Warren County was 79% higher overall, 55% higher in males, and 177% higher in females (Table 5-3). All rate differences for HPV-related oral cancers were statistically significant. Rates for non-HPV-associated cancers were also higher in Warren County for both males and females, although the rates were not statistically different from the reference rates.

Table 5-2 Distribution (%) of Reported Tobacco Use among Oral Cancer Cases by Sex for Warren County, 2011-2015

Tobacco Use	Male and Female	Male	Female
Current	26.8	27.1	26.1
Prior	31.0	29.2	34.8
Never	25.4	25.0	26.1
Unknown	16.9	18.8	13.0

Table 5-3 Oral Squamous Cell Carcinoma Incidence Rates[1] by Sex and HPV Association, Warren County and New York State excluding New York City, 2011-2015

HPV-Associated	Male & Female		Male		Female	
	Warren County	NYS excl. NYC	Warren County	NYS excl. NYC	Warren County	NYS excl. NYC
Yes	8.4 *	4.7	12.4 *	8.0	4.7 *	1.7
No	6.1	4.9	7.8	6.9	4.3	3.1

[1] Incidence rate was age-adjusted to the 2000 US standard population.

** The rate for Warren County is statistically different from the rate for NYS excl. NYC at $p<0.05$ level.*

Discussion

The incidence of oral cancer has been elevated in Warren County compared to NYS excluding NYC for two decades, with excesses in both males and females. During the 2011-2015 period, the observed excess was associated with people aged 50-64 years, with regional-stage tumors, and with squamous cell histology. Squamous cell carcinoma is the cell type associated with all the known risk factors for oral cancers, and this elevation of squamous cell carcinomas by itself can explain the observed excess of oral cancer in Warren County.

Tobacco has been documented as an important risk factor for oral cancer in the literature.[2,9,14] That a majority of oral cancer patients in this study were reported as current or prior tobacco users highlights the impact of tobacco use on developing oral cancer. The combined 2013-2014 and 2016 e-BRFSS data report that a higher proportion of adults (especially women) in Warren County were likely to be current cigarette smokers than were women in NYS excluding NYC (Tables 3-2, A-II-4 and A-II-5). Other historical e-BRFSS data suggest higher rates of cigarette smoking In Warren County in the past.[15,16] Therefore, smoking is likely to have contributed to the excess of oral cancer in Warren County.

Alcohol consumption, especially heavy drinking, is also associated with oral cancer.[3,17] Further, the joint consumption of tobacco and alcohol has a synergistic effect on developing oral cancer.[18,19] According to the 2008 e-BRFSS, after adjusting for age, 9% and 6% of adults in Warren County and NYS excluding NYC, respectively, were heavy drinkers.[16] The combined 2013-2014 and 2016 e-BRFSS data suggest a higher percentage of binge drinkers among men in Warren County relative to NYS excluding NYC (Tables 3-2 and A-II-4). The data also indicate that, among men aged 64 years and younger, the prevalence of being both a current smoker and a binge drinker was higher in Warren County than in NYS excluding NYC (Table A-II-6 in Appendix II). Thus, the excess of oral cancer in Warren County is possibly associated with alcohol use, in particular through an interaction with cigarette smoking among men.

Incidence rates for HPV-related squamous cell tumors were statistically significantly higher in Warren County than in NYS excluding NYC, and the excess in Warren County during the 2011-2015 period was consistent with the elevation of HPV-associated oral cancers. Although some studies have observed strong associations of HPV-positive oral tumors with various measurements of sexual behavior,[20-22] we could not evaluate either HPV-status or any impact of sexual practice on the observed excess of oral cancer incidence in Warren County. Oral cancers that are associated with HPV are also associated with alcohol and tobacco use in the absence of HPV infection, and since the annual number of oral cancer cases in Warren County is relatively small and fluctuating, these findings should be interpreted with caution.

A diet low in fruits and vegetables is another possible risk factor for oral cancer.[12] The 2008 e-BRFSS results showed that a slightly lower percentage of adults in Warren County (25%) consumed five or more servings of fruits and vegetables daily compared to NYS excluding NYC (28%).[16] These differences are not significant, and while suggestive of a poorer diet among

residents of Warren County at that time, diet is unlikely to have contributed substantially to the oral cancer excess observed in 2011-2015.

Studies suggest exposure to formaldehyde increases the risk for oral cancer, in particular nasopharyngeal cancer. The 2011 and 2014 NATA data show that the estimated cancer risk from formaldehyde inhalation exposure is similar in Warren County and NYS excluding NYC (Tables 4-1 and 4-2). Additionally, the lifetime cancer risk associated with formaldehyde inhalation exposure is extremely small and therefore, would have a negligible effect on the excess of oral cancer incidence in Warren County.

Compared to NYS excluding NYC, Warren County has a somewhat greater proportion of people working in occupations with a higher probability of workplace exposures to elevated levels of hazardous substances. Elevated exposures to various cancer-causing substances in the workplace are more likely to occur in these types of occupations, although the particular exposures would differ for different occupations and possibly even workplaces. There were insufficient data available to evaluate the possible contributions of specific occupations that are known to have a higher risk of oral cavity, pharyngeal and nasopharyngeal cancers. Studies on United Kingdom (UK) populations have estimated that less than 0.5% of oral cavity and pharyngeal cancer cases are attributable to occupational exposure.[23,24] Overall, the impact of higher occupational exposure on the excess of oral cancer in Warren County would be minimal.

6. Esophageal Cancer

Overview

The esophagus is the long, muscular tube that connects the throat to the stomach. Squamous cell carcinoma and adenocarcinoma are the two most common types of esophageal cancer. Historically, squamous cell carcinoma has been the more common type in the United States, although the incidence of adenocarcinoma has risen dramatically over the last few decades.[1] Incidence rates for esophageal cancer and its subtypes are much higher in men than in women.[2]

Risk Factors

It is estimated that tobacco and alcohol use account for as much as 90% of squamous cell carcinomas of the esophagus in developed countries such as the United States.[3] For adenocarcinoma of the esophagus, in addition to a moderate effect from smoking,[4,5] being overweight or obese increases the risk.[6] Another risk factor for adenocarcinoma of the esophagus is gastroesophageal reflux disease (GERD).[7] GERD occurs when stomach acid frequently flows back into the esophagus, and causes symptoms such as heartburn and regurgitation.[8] Over time, GERD may damage cells in the lower esophagus, a condition known as Barrett's esophagus, which, in turn, may lead to esophageal adenocarcinoma. In fact, Barrett's esophagus is often considered a precursor to this cancer.[9] Some studies suggest that diets low in fruits and vegetables may be associated with esophageal cancer.[10] Exposure to radiation increases the risk of esophageal cancer,[11] and higher risks have also been found among workers in the dry cleaning and rubber industries.[12]

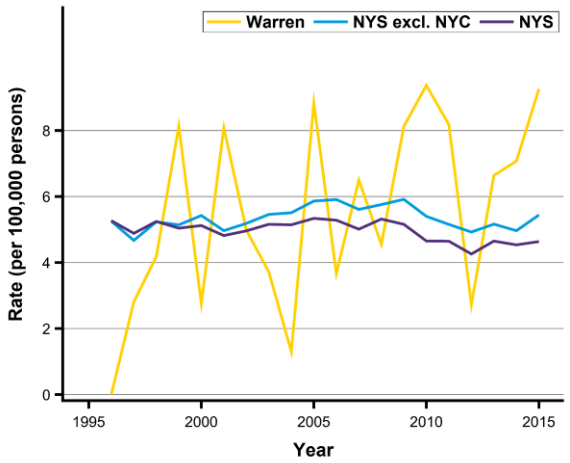
Findings

From 1996 through 2015, the annual number of esophageal cancer cases for Warren County ranged from 0 to 9 and the incidence rate of esophageal cancer varied substantially from year to year (Fig. 6-1(A)). Nevertheless, there seemed to be a suggestive upward trend in Warren County. The 5-year average rate in Warren County increased from 3.6 per 100,000 persons in 1996-2000 to 6.7 in 2011-2015, though these two rates were statistically comparable (Fig. 6-1(B)). In comparison, the annual incidence rate for NYS excluding NYC remained in the range of 4.7 to 5.9 per 100,000 persons over the 20-year period, with an increasing trend until 2009. Annual rates for NYS were slightly lower than NYS excluding NYC, ranging between 4.3 and 5.3, but with a similar pattern. The incidence rate for Warren County was statistically significantly elevated only in the 2011-2015 reporting period (6.7 per 100,000 persons) relative to NYS (4.5).

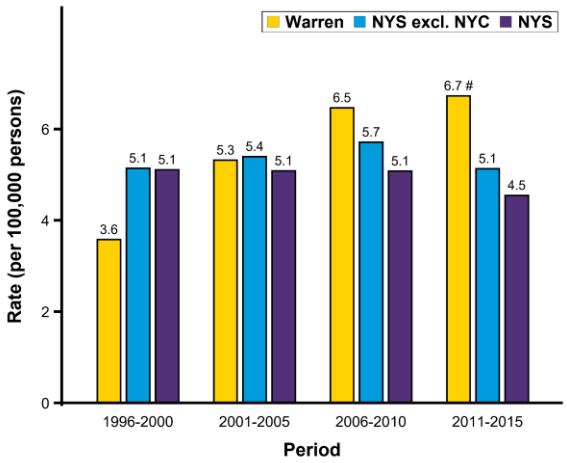
Among men, between 2011 and 2015, the incidence rates for Warren County, NYS excluding NYC, and NYS were 12.6, 8.7, and 7.7 per 100,000 persons, respectively (Table A-II-2 in Appendix II). The difference between Warren County and NYS was statistically significant, but not the difference between Warren County and NYS excluding NYC. Among women, the rate for

Figure 6-1 Esophageal Cancer Incidence Rates[1] for Warren County, New York State excluding New York City, and New York State, 1996-2015

(a) Annual Rate



(b) 5-year Average Rate



[1] *Incidence rate was age-adjusted to the 2000 US standard population.*

[#] *The rate for Warren County is statistically different from the rate for NYS at p<0.05 level.*

Table 6-1 Male Esophageal Cancer Incidence Rates[1] by Age Group, Warren County, New York State excluding New York City, and New York State, 2011-2015

Age Group (years)	Warren County	NYS excl. NYC	NYS
20-49	2.8	1.4	1.2
50-64	24.8	17.1	14.8
65+	60.6	44.0	39.6

[1] *Incidence rate (per 100,000 persons) was age-adjusted to the 2000 US standard population.*

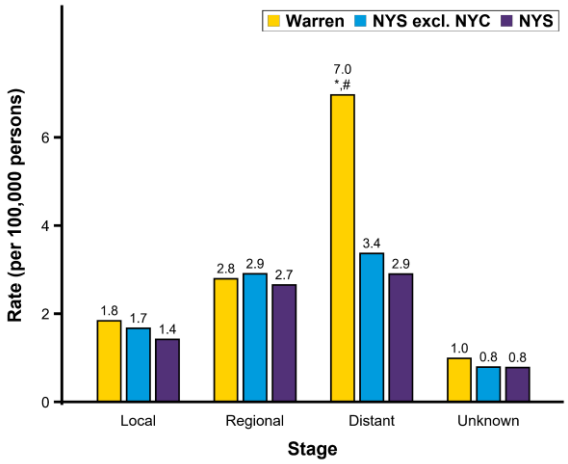
Warren County of 1.8 per 100,000 persons was similar to the values of 2.1 for NYS excluding NYC and 2.0 for NYS (Table A-II-3 in Appendix II). Consequently, the observed excess in esophageal cancer was fully attributable to men.

Between 2011 and 2015, among male esophageal cancer patients in Warren County the average age at diagnosis was about 67 years old, with a range of 47 to 89. Incidence increased sharply with age (Table 6-1). The rate for Warren County was higher than both NYS excluding NYC and NYS for every age category. None of the elevations were significantly different, likely due to the lack of power given the small number of cases in Warren County.

The incidence rates among males diagnosed at localized and regional stages were similar among Warren County, NYS excluding NYC, and NYS (Fig. 6-2). For distant-stage disease, however, the rate (7.0 per 100,000 persons) was significantly higher, in fact more than doubled, when compared to NYS excluding NYC at 3.4 and NYS at 2.9. This excess accounts for virtually all of the observed excess in Warren County in the 2011-2015 period.

Nationally, the distribution of esophageal cancer cases by histological subtype differs significantly among racial groups.[2,4,13] Nearly all of the population of Warren County is non-Hispanic white, and all 34 cases (29 males and 5 female) diagnosed here between 2011 and 2015 were among non-Hispanic whites. Therefore, analysis by subtype was restricted to male non-Hispanic whites. In Warren County, 90% of the cases were either squamous cell carcinoma or adenocarcinoma, similar to the 94% in both NYS excluding NYC and NYS. The incidence rate of squamous cell carcinoma in Warren County (4.8 per 100, 000 persons) was significantly higher than in NYS excluding NYC (1.5) and in NYS (1.5), while the rates of adenocarcinoma were comparable (Table 6-2). Among males, 84% of the excess in Warren County relative to NYS excluding NYC was accounted for by the elevation in squamous cell carcinoma incidence. For the comparison with NYS, this figure was 72%.

Figure 6-2 Male Esophageal Cancer Incidence Rates[1] by Stage at Diagnosis, Warren County, New York State excluding New York City, and New York State, 2011-2015



[1] Incidence rate was age-adjusted to the 2000 US standard population.

** The rate for Warren County is statistically different from the rate for NYS excl. NYC at p<0.05 level.*

[#] The rate for Warren County is statistically different from the rate for NYS at p<0.05 level.

Table 6-2 Male Esophageal Cancer Incidence Rates[1] by Histological Subtype among non-Hispanic Whites, Warren County, New York State excluding New York City, and New York State, 2011-2015

Subtype	Warren County	NYS excl. NYC	NYS
Squamous cell carcinoma	4.8 *,#	1.5	1.5
Adenocarcinoma	6.8	7.0	6.3
Other malignant tumors	1.4	0.5	0.6

[1] Incidence rate (per 100,000 persons) was age-adjusted to the 2000 US standard population.

** The rate for Warren County is statistically different from the rate for NYS excl. NYC at p<0.05 level.*

[#] The rate for Warren County is statistically different from the rate for NYS at p<0.05 level.

Among males diagnosed with esophageal cancer between 2011 and 2015, about 20% of the patients in Warren County, NYS excluding NYC, and NYS had a previous tumor. Comparable proportions of patients in all three areas received radiation treatment. It is therefore unlikely that prior exposure to radiation treatment contributed to the observed excess of esophageal cancer in Warren County.

Among male esophageal cancer patients, 17% and 69% were current and former tobacco users, respectively. Only 3% were reported to have never consumed any tobacco products.

Discussion

The incidence rate of esophageal cancer has been decreasing slightly in NYS excluding NYC and NYS, as well as nationwide,[4] in recent years (Fig. 6-1). However, Warren County has not followed this trend (Fig. 6-1). From 2011 through 2015, the incidence rate among males was higher among diverse age groups, with the largest relative difference among those aged 20-49 (Table 6-1). In addition, the elevation in the incidence rate of distant-stage cancers was substantial (Fig. 6-2). All of these are troubling signs. However, the annual count of cases reported for Warren County is in the single digits. Therefore, interpretation and generalization of these findings need to be conducted with caution.

In Warren County, about 86% of men diagnosed with esophageal cancer were current or former users of tobacco products, supporting the fact that smoking is an important modifiable risk factor for esophageal cancer.[14] This is further supported by the finding that the elevation in Warren County was primarily seen for squamous cell carcinoma, a subtype with a strong association with smoking. The combined 2013-2014 and 2016 e-BRFSS suggest that a higher proportion of men in Warren County were current cigarette smokers than were men in NYS excluding NYC (Tables 3-2 and A-II-4). Previous e-BRFSS data also suggest a higher prevalence of cigarette smoking in Warren County in the past.[15,16] Therefore, smoking is likely to have contributed to the excess of esophageal cancer in Warren County.

Alcohol consumption is associated with esophageal cancer, in particular squamous cell carcinoma.[17] The 2008 e-BRFSS report shows that, after adjusting for age, 9% of adults in Warren County were heavy drinkers, compared with 6% in NYS excluding NYC and 5% in NYS.[16] Additionally, the combined 2013-2014 and 2016 e-BRFSS data suggest a higher percentage of binge drinkers among men in Warren County (Table 3-2). The data also indicate that, among men aged 64 years and younger, the prevalence of being both a current smoker and a binge drinker was higher in Warren County compared to NYS excluding NYC (Table A-II-6 in Appendix II). Although survey results might not apply at the individual level, it is possible that drinking, independently or through a joint effect with tobacco use, played a contributory role in the excess of esophageal cancer in Warren County as well.

A diet low in fruits and vegetables is another possible risk factor for esophageal cancer.[10,14] The 2008 e-BRFSS results showed that a slightly lower percentage of adults in Warren County (25%) consumed five or more servings of fruits and vegetables daily compared to NYS excluding NYC (28%) and NYS (27%).[16] These differences are small and not statistically significant, and while might be suggestive of an unfavorable dietary pattern among residents of Warren County in the past, they are unlikely to have contributed substantially to esophageal cancer excess observed in 2011-2015.

Compared to NYS excluding NYC, Warren County has a slightly greater proportion of people working in occupations with a higher probability of workplace exposures to elevated levels of hazardous substances. Elevated exposures to various cancer-causing substances in the workplace are more likely to occur in these types of occupations, although the particular exposures would differ for different occupations and possibly even workplaces. There were insufficient data available to evaluate the possible contributions of specific occupations that are known to have a higher risk of esophageal cancer, such as workers in the dry cleaning and rubber industries. Studies on UK populations have estimated that less than 3% of esophageal cancer cases, specifically 3.3% in male and 1.1% in females, are attributable to occupational exposure.[18,19] Overall, the impact of higher occupational exposure on the excess of esophageal cancer in Warren County would probably be minor.

7. Colorectal Cancer

Overview

Colorectal cancers include cancers of the colon (the large intestine) and the rectum (the final section of the large intestine). Colorectal cancer is the second leading cause of death from cancer in the United States, after lung cancer.[1] The American Cancer Society estimates there were about 140,000 new cases of colorectal cancer nationwide in 2018, with 54% in males and 46% in females.[1] About 9,000 of these cases were among New York State residents.

Risk Factors

A number of lifestyle factors are associated with colorectal cancer. These include cigarette smoking,[2] heavy alcohol use,[3] and physical inactivity.[4] Many studies suggest that diet may be important, particularly the high consumption of red or processed meats[5] and the low consumption of fruit, vegetables, and fiber.[6] People who are overweight or obese also have a greater risk of developing colorectal cancer.[7] A family history of colorectal cancer is important,[8] as is a personal history of intestinal polyps or chronic inflammatory bowel disease.[9] The long-term use of low-dose aspirin has been associated with a reduction in the risk of colorectal cancer,[10] as has the use of female hormone replacement therapies that combine estrogen and progestin.[11] Some studies also suggest that calcium intake may protect against colorectal cancer.[12] Regarding environmental exposures, a few studies indicate a higher risk for persons exposed to ionizing radiation[13] or asbestos,[14] but these findings need further confirmation.

Findings

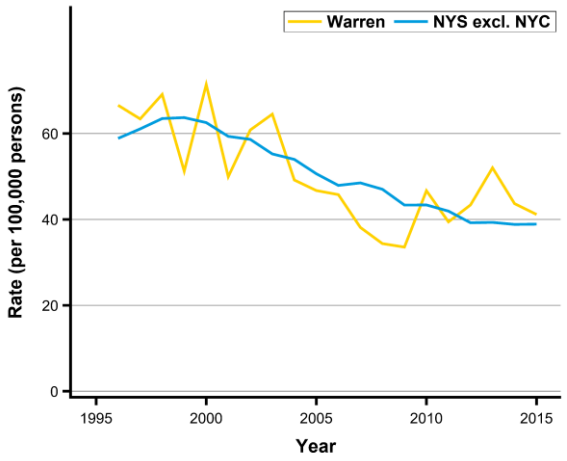
From 1996 through 2015, the annual count of colorectal cancer cases in Warren County ranged from 31 to 53, and the incidence rate was comparable to that for NYS excluding NYC (Fig. 7-1). The incidence in NYS excluding NYC has been declining since 1999. In general, the incidence of colorectal cancer in Warren County has also shown a downward trend.

Stratification by sex showed that the incidence rates of colorectal cancer among males were similar in Warren County and NYS excluding NYC (42.9 versus 45.0 per 100,000; Table A-II-2 in Appendix II). As for females, the incidence rate was 25% higher in Warren County than in NYS excluding NYC, which was statistically significant (43.9 versus 35.2 per 100,000; Table A-II-3). Therefore, the observed excess of colorectal cancer in Warren County during the 2011-2015 period was entirely associated with females.

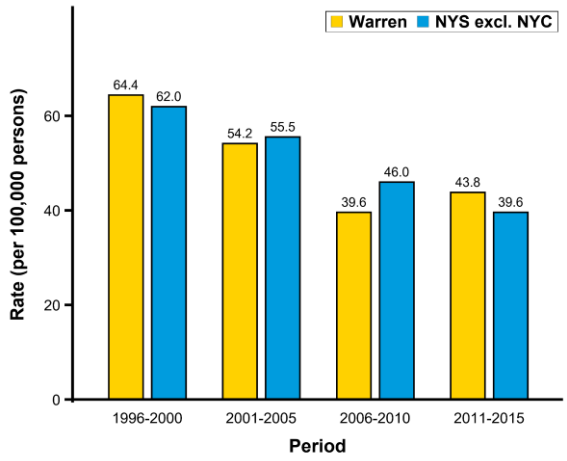
We first considered whether the excess among females in Warren County was related to women diagnosed with more than one colorectal tumor, all of which were included in the rate calculations. In both Warren County and NYS excluding NYC, about 3% of the female patients were diagnosed with 2-4 primary colorectal cancers between 2011 and 2015. Excluding these

Figure 7-1 Colorectal Cancer Incidence Rates[1] for Warren County and New York State excluding New York City, 1996-2015

(a) Annual Rate



(b) 5-year Average Rate



[1] Incidence rate was age-adjusted to the 2000 US standard population.

Table 7-1 Female Colorectal Cancer Average Annual Cases and Incidence Rates[1] by Age Group, Warren County and New York State excluding New York City, 2011-2015

Age Group (years)	Warren County		NYS excl. NYC	
	Ave. Annual Cases	Rate	Ave. Annual Cases	Rate
0-19	0.2	2.7	6.8	0.5
20-49	3.0	25.1 *	266.8	12.3
50-74	8.4	69.2	1,243.4	73.2
75+	9.4	285.7	1,171.4	230.5

[1] Incidence rate was age-adjusted to the 2000 US standard population.

** The rate for Warren County is statistically different from the rate for NYS excl. NYC at p<0.05 level.*

tumors from the analysis had no impact on the relative difference between the two populations.

We next evaluated colorectal cancer incidence by broad age groups. Between 2011 and 2015, the rate for females aged 20-49 years in Warren County was 25.1 per 100,000 persons, statistically significantly higher than the 12.3 for NYS excluding NYC (Table 7-1). Additionally, the incidence among elderly women (75 years of age and older) in Warren County was 24% higher, though this elevation was not statistically significant. However, among the screening-age population (i.e., 50-74 years), there was no elevation in incidence. Overall, 52% of the observed excess among females in Warren County women was accounted for by the excess among the elderly, and 45% by the excess among young adult women.

Further stratification of female colorectal cancer incidence by age group and subsite showed higher rates in the generally unscreened adult populations (i.e., the young and the elderly) in Warren County for both colon and rectal tumors (Table 7-2), although only the 155% elevation in rectal cancer among young adult women was statistically significant when compared to NYS excluding NYC. In Warren County, 47% of the colorectal tumors occurred in the rectum among young adult patients compared with 21% among the elderly. Similar percentages were observed for cancer patients in NYS excluding NYC. Therefore, the excess of colorectal cancer among elderly women was largely due to an elevation in colon cancer (68%), while most (56%) of the excess among young adult women was associated with rectal cancer.

Table 7-2 Female Colorectal Cancer Incidence Rates[1] by Age Group and Subsite for Warren County and New York State excluding New York City, 2011-2015

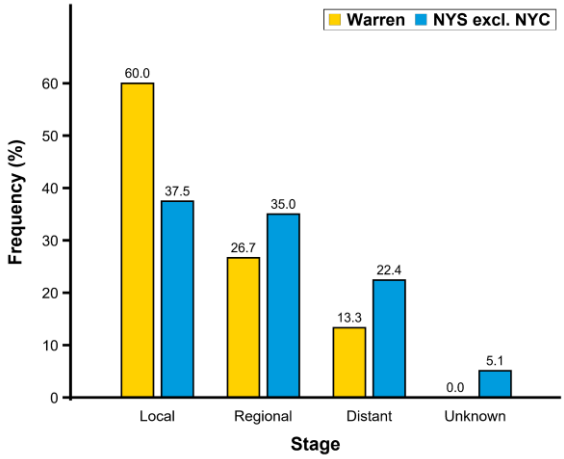
Age Group (years)	Colon excl. Rectum		Rectum & Rectosigmoid	
	Warren County	NYS excl. NYC	Warren County	NYS excl. NYC
0-19	2.7	0.4	0.0	0.0
20-49	13.2	7.6	11.9 *	4.7
50-74	50.8	52.0	18.3	21.2
75+	225.9	188.4	59.8	42.1
All Ages	31.2	26.0	12.8	9.2

[1] *Incidence rate was age-adjusted to the 2000 US standard population.*

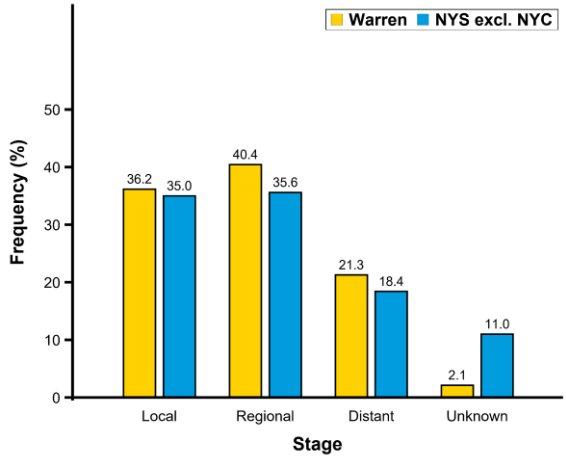
** The rate for Warren County is statistically different from the rate for NYS excl. NYC at p<0.05 level.*

Figure 7-2 Female Colorectal Cancer Cases by Stage at Diagnosis among Selected Age Groups for Warren County and New York State excluding New York City, 2011-2015

(A) 20-49 years



(B) 75+ years



The distribution of stage at diagnosis was examined, focusing on female cases who were 20-49 years of age or 75 and older at the time of diagnosis. Results are shown in Figure 7-2. An elevated proportion of young women were diagnosed with local-stage tumors in Warren County (60%) than in NYS excluding NYC (37%), though the difference was not statistically significant due to the small number of cases. As to elderly women, the proportions of colorectal cancers diagnosed at different stages were similar in these two areas.

Among young female patients (<50 years of age) in Warren County, 38% were reported to have consumed tobacco products in their lifetime, compared with 64% and 36% of females aged 50-74 years and 75+ years, respectively.

Discussion

In Warren County, there was a significant elevation of colorectal cancer incidence among young female adults during 2011-2015 (Tables 7-1). Different from other findings on young-onset colorectal cancer,[22,23] the majority of the cases in Warren County were diagnosed with local-stage tumors instead of advanced-stage tumors (Fig. 2-(A)). Therefore, the excess of colorectal cancer might reflect higher insurance coverage (Table A-II-5 in Appendix II), extensive availability of clinical care (Table 3-3), and increased clinical vigilance of symptomatic young adult patients in Warren County.

Studies have examined colorectal cancer in young adults along clinical, pathologic, and molecular dimensions,[25-30] and evidence suggests that young-onset disease may be somewhat different from colorectal cancer diagnosed in the older population.[30] In particular, it is estimated that up to half of the early-onset colorectal cancer cases have hereditary cancer syndromes or familial colorectal cancer.[25] Due to the lack of medical information, this study was unable to investigate their roles in the excess of colorectal cancer among young adults in Warren County.

Studies of risk factors for young-onset colorectal cancer are still limited. A family history of colorectal tumors remains a strong predictor.[26,31-33] Several studies suggest obesity to be a likely factor.[18,34-36] Unhealthy dietary patterns may play a contributory role.[31,34] However, findings from studies examining other traditional risk factors, such as diabetes,[31,32,34,36] smoking,[36-39] alcohol consumption,[31,32,37,38] sedentary lifestyle and physical inactivity[31,37,38] are conflicting or inconclusive. The combined e-BRFSS results provide information on some of these health and behavioral factors, and thus allow us to qualitatively explore the potential sources for the marked excess among young females in Warren County (Fig. 3-2; Tables A-II-4 & A-II-5 in Appendix II). For instance, results suggest that greater proportions of women aged 20-49 years in Warren County were either obese or current cigarette smokers than in NYS excluding NYC. However, a significantly higher proportion of young women engaged in leisure time physical activity in Warren County. In addition, the prevalence of binge drinking among young females in these two areas was similar. Therefore, it is plausible that obesity and cigarette smoking may have contributed to the observed excess in young-onset colorectal cancer in Warren County, and that this might have been offset by the higher proportion of young adults engaged in

leisure time physical activity. In interpreting BRFSS data, we need to keep in mind that cancers develop over many years and therefore are more likely to be associated with past rather than current behavior.

Half of the excess of colorectal cancer among females in Warren County, when compared to NYS excluding NYC, was found among the elderly population. Traditionally, a number of modifiable risk factors have been linked with colorectal cancer and these were summarized above. Data from the combined 2013-2014 and 2016 e-BRFSS provide very limited information for those aged 75 years and older in Warren County, and the estimates that are available are highly variable (Tables A-II-4 & A-II-5 in Appendix II). Results suggest that elderly women in Warren County were heavier, but more likely to get leisure time physical activity than those in NYS excluding NYC. Thus, the excess in colorectal cancer among the elderly women in Warren County might be associated with excess body fat, again possibly offset by the benefits of engaging in leisure time physical activity.

Screening for colorectal cancer by colonoscopy actually reduces incidence rates by removing pre-malignant lesions. The USPSTF recommends screening beginning at age 50 and continuing through age 75. We have no data on when elderly women were last screened. However, results from the combined 2013-2014 and 2016 e-BRFSS suggest women aged 65 and older in Warren County may be less likely to fully meet screening recommendations relative to women in NYS excluding NYC (Table A-II-5). Therefore, factoring in disease progression after a negative screen, it is possible that the elevated incidence rate among females 75 years of age and older represents missed screening opportunities among women 65-75 years of age and older.

A causal association between asbestos and colorectal cancer has not been established although some studies suggest an association.[40-42] Examination of asbestosis hospitalization rates, a proxy for exposure to asbestos, found no difference in hospitalization rates between Warren County and NYS excluding NYC (Table 3-5). Therefore, it is unlikely that the excess of colorectal cancer in Warren County is due to exposure to asbestos.

8. Laryngeal Cancer

Overview

Laryngeal cancer is a rare disease, in which malignant cells form in the tissue of the larynx (the voice box). It occurs more frequently in men than women.[1,2] It is usually diagnosed among people in their 50s and older.[3,4]

Risk Factors

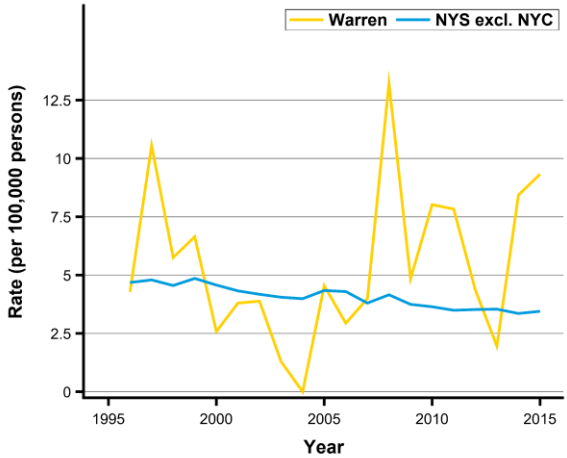
The strongest risk factor for laryngeal cancer is smoking.[5] This cancer is also associated with the consumption of alcoholic beverages, with the risk increasing according to the number of drinks per day.[6] In fact, some studies estimate that smoking may account for 70% of cancer of the larynx, and alcohol another 20%.[7] People who smoke and are heavy drinkers have a much greater risk than people who do either one alone.[8] Workers exposed to chemical agents such as sulfuric acid mists are also at higher risk of this disease[9], as are workers exposed to asbestos.[10]

Findings

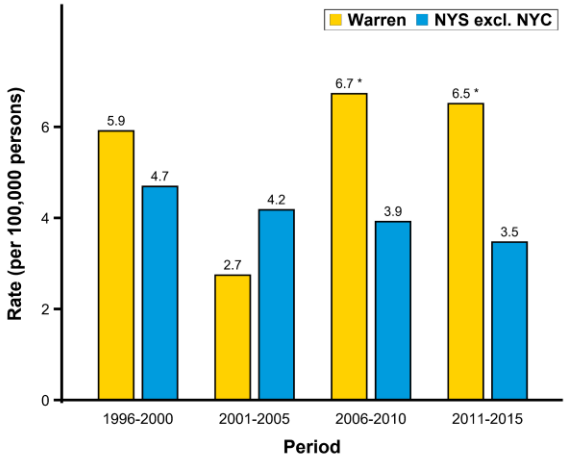
From 1996 through 2015, the number of laryngeal cancer cases diagnosed annually in Warren County was small and highly variable, ranging from 0 to 11 cases. Thus, the annual incidence rate fluctuated greatly (Fig. 8-1(A)). The rate in NYS excluding NYC has declined steadily since 1996, whereas there has been no decline in Warren County. In the two most recent 5-year periods, rates in Warren County were nearly double those of NYS excluding NYC, and the elevations were statistically significant (Fig. 8-1(B)).

Figure 8-1 Laryngeal Cancer Incidence Rates[1] for Warren County and New York State excluding New York City, 1996-2015

(A) Annual Rate



(B) 5-year Average Rate



[1] Incidence rate was age-adjusted to the 2000 US standard population.

** The rate for Warren County is statistically different from the rate for NYS excl. NYC at p<0.05 level.*

During the 2011-2015 period, 30 residents of Warren County were diagnosed with laryngeal cancer, 23 men and seven women. The incidence rate among males in Warren County was 10.9 per 100,000 persons, statistically significantly higher than the 6.0 in NYS excluding NYC. Women had a rate that was proportionally higher (2.8 versus 1.4 per 100,000 persons), but of much lower magnitude and not statistically different from that of NYS excluding NYC. Therefore, the observed excess can be primarily attributed to the elevation in males. Subsequent findings are focused on males.

All laryngeal cancers in these two areas were diagnosed in adults (i.e., 20 years of age and older). However, the average age at diagnosis among males in Warren County was five years younger than in NYS excluding NYC, 61 versus 66. The incidence rates for Warren County males age 20-49 and 50-64 were about seven times and twice as high, respectively, compared to the rates in NYS excluding NYC (Fig. 8-2). The elevation among men was nearly entirely limited to those under 65 years of age.

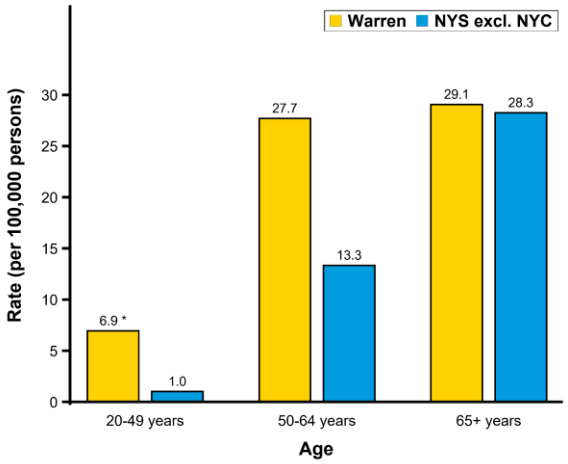
Men in Warren County were more likely to be diagnosed at localized stage (74%) than men in NYS excluding NYC (56%). Nearly all excess incidence is attributable to cases diagnosed at localized stage (Fig. 8-3).

An overwhelming majority of male laryngeal cancer patients in Warren County were reported to the NYSCR as either current (61%) or former tobacco users (35%).

Discussion

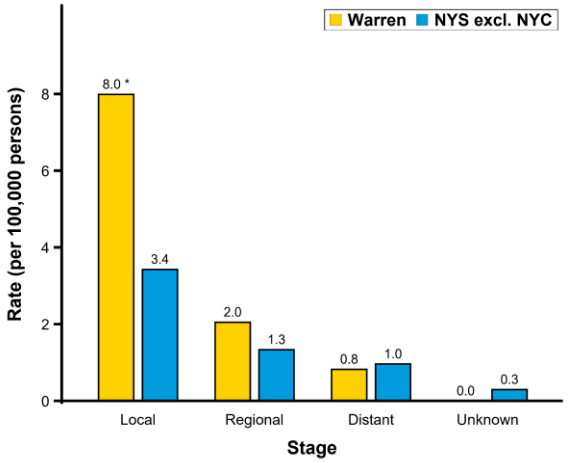
The incidence rate of laryngeal cancer has been declining in NYS excluding NYC as well as nationwide in recent years,[11] but thus far

Figure 8-2 Male Laryngeal Cancer Incidence Rates[1] by Age Category for Warren County and New York State excluding New York City, 2011-2015



[1] Incidence rate was age-adjusted to the 2000 US standard population.
** The rate for Warren County is statistically different from the rate for NYS excl. NYC at p<0.05 level.*

Figure 8-3 Male Laryngeal Cancer Incidence Rates[1] by Stage at Diagnosis for Warren County and New York State excluding New York City, 2011-2015



[1] Incidence rate was age-adjusted to the 2000 US standard population.
** The rate for Warren County is statistically different from the rate for NYS excl. NYC at p<0.05 level.*

rates in Warren County have not followed the downward trend (Fig. 8-1). The mix of cases in Warren County differed from NYS excluding NYC, with the excess attributable to diagnoses among men under age 65, albeit at a localized, and hence more treatable, stage. Since laryngeal cancer incidence increases with age, the younger age distribution is disturbing, as it suggests that laryngeal cancer rates in Warren County may continue to increase as the population ages. However, since the number of cases reported in Warren County is low and varies substantially from year to year, these findings are based on highly variable rates.

Most laryngeal cancer patients in this study had been tobacco users at some point in their life, consistent with smoking as a major risk factor for laryngeal cancer. The combined 2013-2014 and 2016 e-BRFSS data suggest that men in Warren County were more likely to smoke cigarettes than men in NYS excluding NYC (Table 3-2). Earlier e-BRFSS data also indicate higher smoking prevalence among men in Warren County in the past.[12,13] Therefore, it is likely that elevated tobacco use in Warren County has contributed to the observed excess in laryngeal cancer.

According to the 2008-2009 e-BRFSS, after adjusting for age, 9% and 6% of adults in Warren County and NYS excluding NYC, respectively, were heavy drinkers.[13] Additionally, the combined 2013-2014 and 2016 e-BRFSS data suggest a higher percentage of binge drinkers among men in Warren County (Table 3-2). The data also indicate that, among men aged 64 years and younger, the prevalence of being both a current smoker and a binge drinker was higher in Warren County compared to NYS excluding NYC (Table A-II-6 in Appendix II). Although they might not apply at the individual level, these population-level survey results suggest that alcohol consumption, independently or synergistically due to an interaction with cigarette smoking, may account for some of the Warren County excess in laryngeal cancer.

Owing to the lack of individual-level occupational exposure data, this study was unable to directly investigate the roles of sulfuric acid and asbestos, known risk factors for laryngeal cancer. Both mining, and paper and pulp production used small quantities of sulfuric acid in their operations,[14] and these industries used to be economic pillars in Warren County. Therefore, it is plausible that people (especially men) in Warren County may have been exposed to sulfuric acid at some point in their lives, potentially affecting their risk of laryngeal cancer. As to asbestos, for this study we used asbestosis hospitalization rates as an indirect measure of past occupational exposure to asbestos. Since the asbestosis hospitalization rates for Warren County were not elevated relative to those for NYS excluding NYC (Table 3-5), it is unlikely that past occupational exposure to asbestos was higher in Warren County. Overall, the impact of higher occupational exposure on the excess of laryngeal cancer in Warren County would probably be minor. Studies on UK populations have estimated that less than 3% of laryngeal cancer cases are attributable to occupational exposure.[15,16]

That a higher proportion of laryngeal cancers were diagnosed at an early, localized, stage in Warren County as compared to NYS excluding NYC raises the possibility that some of these tumors may have been diagnosed due to clinical vigilance and more interactions with the

health care system, because of higher insurance coverage (Table 3-2) and good access to clinical care (Table 3-3).

9. Lung Cancer

Overview

Although rates have declined in recent years, lung cancer remains the leading cause of death from cancer for both men and women in the United States.[1] The American Cancer Society estimates there were about 13,000 new cases of lung cancer among New York State residents in 2018.[2]

Most lung cancers fall into one of two categories: small cell and non-small cell lung cancers. Small cell lung cancer is less common than non-small cell lung cancer. Non-small cell lung cancer is a collective term for several subtypes of lung cancers that behave in a similar way, the most common of which are adenocarcinoma, squamous cell carcinoma, and large cell carcinoma.

Risk Factors

Cigarette smoking is considered to be the most important risk factor for this disease; according to the American Lung Association, between 80% and 90% of all lung cancer cases in the United States may be attributed to smoking.[3] Second-hand smoke is also an established risk factor. [4] Although smoking increases the risk for all types of lung cancer, the risk is greatest for small cell and squamous cell carcinomas, and weakest for adenocarcinomas.[5-7]

Factors other than smoking can also cause lung cancer. Among environmental exposures, radon is believed to be an important cause of lung cancer.[8] Radon is a colorless and odorless radioactive gas that is a product of uranium degradation. It occurs naturally in rock and soil, and it enters homes through the basement. The EPA suggests that residential exposure to radon may be second only to cigarette smoking as a cause of lung cancer in the United States.[9] Air pollution, including small particles and toxic substances, is also related to lung cancer.[10] Exposure to other chemicals and substances that can cause lung cancer occurs primarily, but not exclusively, in the workplace. These include asbestos and arsenic, as well as chloromethyl ethers, beryllium, chromium, cadmium, nickel, silica, diesel exhaust, and soot.[11]

Ionizing radiation to the chest from medical procedures has been implicated in the development of lung cancer.[12] Also, as with many cancers, a positive family history is a risk factor.[13] Some studies suggest that dietary factors such as the consumption of fruits and vegetables may protect against lung cancer, but the evidence supporting this idea is inconclusive.[14]

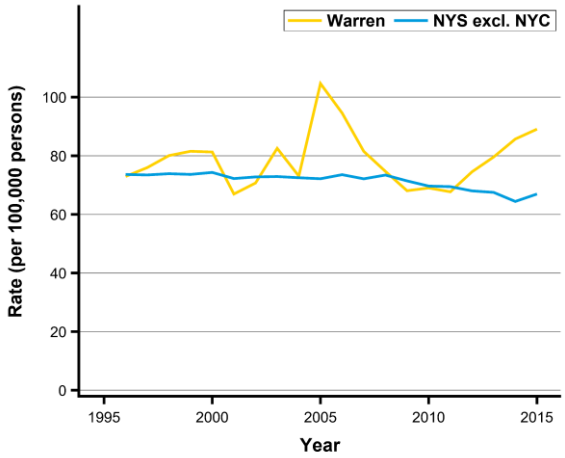
Findings

From 1996 through 2015, the annual number of lung cancer cases for Warren County ranged between 50 and 89, and the incidence rate between 67.0 and 104.7 per 100,000 persons (Fig.

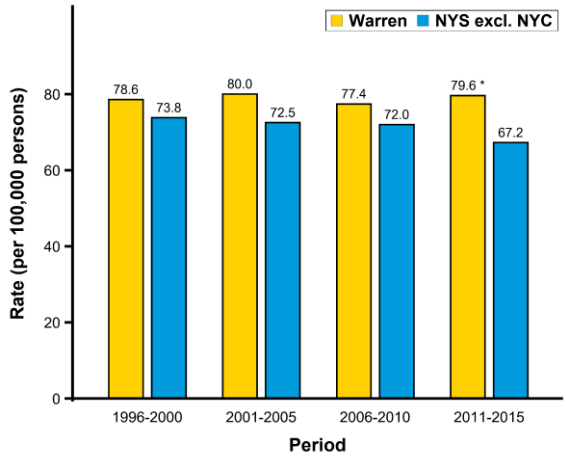
9-1(A)). Nevertheless, the 5-year average rate remained relatively stable over time (Fig. 9-1(B)). In comparison, lung cancer incidence for NYS excluding NYC decreased significantly between the time periods 2006-2010 and 2011-2015, from 72.0 to 67.2. Compared to NYS excluding NYC, incidence of lung cancer in Warren County was elevated in all four periods examined. However, the difference was statistically significant only in the most recent 5-year period.

Figure 9-1 Lung Cancer Incidence Rates[1] for Warren County and New York State excluding New York City, 1996-2015

(A) Annual Rate



(B) 5-year Average Rate



[1] Incidence rate was age-adjusted to the 2000 US standard population.

** The rate for Warren County is statistically different from the rate for NYS excl. NYC at p<0.05 level.*

The average annual incidence rate among males in Warren County during 2011-2015 was 92.8 per 100,000 persons, significantly higher than the 74.5 in NYS excluding NYC (Table A-II-2 in Appendix II). The female lung cancer rates were similar for Warren County and NYS excluding NYC (68.8 versus 62.2 in Table A-II-3). Overall, about 70% of the excess lung cancer in Warren County was attributable to men.

Table 9-1 presents the incidence rates of lung cancer diagnosed in 2011-2015 by sex and broad age groups for both regions. Incidence rates for Warren County males were higher in all adult age categories than for males in NYS excluding NYC, but the elevation was statistically significant only among men aged 50-64. For females, the rates were suggestively higher in all adult age categories; however, the magnitude of elevation was smaller when compared to men of the same age. For both sexes combined, the elevation in the incidence rate for Warren County was statistically significant among younger (aged 20-49 years) and middle-aged adults (50-64 years). Almost sixty percent of the excess was attributable to these two age groups (13% and 45%, respectively), even though only 33% of the lung cancer cases in Warren County were diagnosed among adults younger than 65 years of age.

Table 9-1 Lung Cancer Incidence Rates[1] by Sex and Age Group for Warren County and New York State excluding New York City, 2011-2015

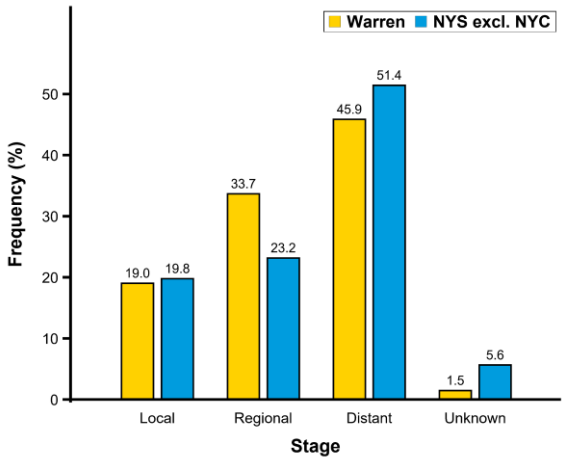
Age Group (years)	Male and Female		Male		Female	
	Warren County	NYS excl. NYC	Warren County	NYS excl. NYC	Warren County	NYS excl. NYC
0-19	0.0	0.1	0.0	0.1	0.0	0.1
20-49	13.2 *	7.0	13.7	6.3	12.8	7.7
50-64	136.8 *	102.4	159.2 *	104.1	115.4	100.9
65+	422.0	386.1	497.6	444.2	363.5	345.8

[1] Incidence rate was age-adjusted to the 2000 US standard population.

** The rate for Warren County is statistically different from the rate for NYS excl. NYC at p<0.05 level.*

Figure 9-2 Distribution of Stage at Diagnosis by Sex, Lung Cancer Cases in Warren County and New York State excluding New York City, 2011-2015

(A) Male



(B) Female

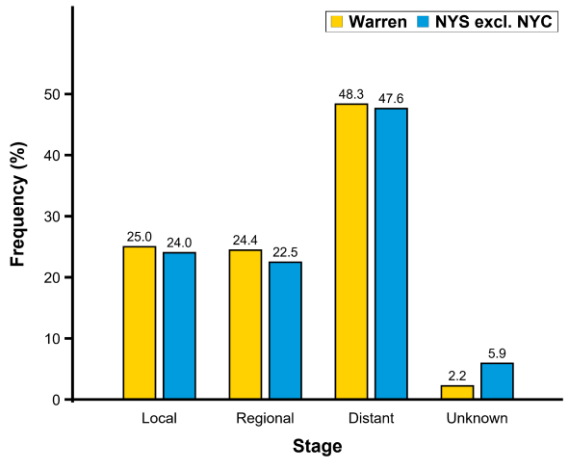


Figure 9-2 shows the stage distribution of lung cancer cases diagnosed in 2011-2015 by sex. Among males, a higher proportion of tumors were diagnosed at regional stage in Warren County (34%) than in NYS excluding NYC (23%). For females, the proportions of cancers diagnosed at different stages were similar between the two areas. Unfortunately, for both males and females, most lung cancers were diagnosed at advanced stages (regional or distant) in both regions. The observed elevation in incidence for Warren County was mostly associated with incidence of advanced-stage tumors (61.1 versus 48.5 per 100,000 persons for Warren County and NYS excluding NYC, respectively).

In Warren County and NYS excluding NYC, for 2011-2015, 86% and 83%, respectively, of all lung cancer cases were either small cell or non-small cell lung cancers. Further evaluation of tumors by subtype showed that adenocarcinomas were the most common lung cancer, and its incidence rates were similar in both regions (Table 9-2). Squamous, small cell, and large cell

carcinomas were the next most common cancers. The incidence rates for these three subtypes were significantly elevated in Warren County, with large cell carcinomas showing the greatest excess. However, this cell type is also less common.

Because radiation exposure is a risk factor for lung cancer and cancer patients are frequently treated with radiation, we examined lung cancer patients who had a prior history of cancer. About 25% of lung cancer patients had been diagnosed with prior tumors in both Warren County and NYS excluding NYC. Similar proportions of patients were ever exposed to radiation treatment for these prior tumors in both regions. Thus, it is unlikely that the excess in lung cancer incidence in Warren County can be attributed to radiation treatment for a prior cancer.

Among all lung cancer cases diagnosed in Warren County during 2011-2015, 84% were reported as current or prior users of tobacco, and 6% were reported as never having consumed tobacco products. For the most common types of lung cancer, similarly small percentages of patients were reported as never having used tobacco products (Table 9-3).

Using NYS excluding NYC as the reference, the expected numbers of lung cancer cases were calculated by census tract in Warren County, and the corresponding relative differences between the observed and expected cases are presented in Figure 9-3. Among the 19 census

Table 9-2 Lung Cancer Annual Cases and Incidence Rates[1] by Histological Subtype for Warren County and New York State excluding New York City, 2011-2015

Subtype	Warren County		NYS excl. NYC		Percent Elevation/Deficit
	Cases	Rate	Cases	Rate	
Small cell lung cancer	12.0	11.8	1096.8	7.7	53.1 *
Non-small cell lung cancer					
Squamous cell carcinoma	17.2	17.5	1919.6	13.8	26.2 *
Adenocarcinoma	27.8	29.5	4220.0	30.0	-1.9
Large cell carcinoma	9.6	9.8	589.2	4.2	136.9 *

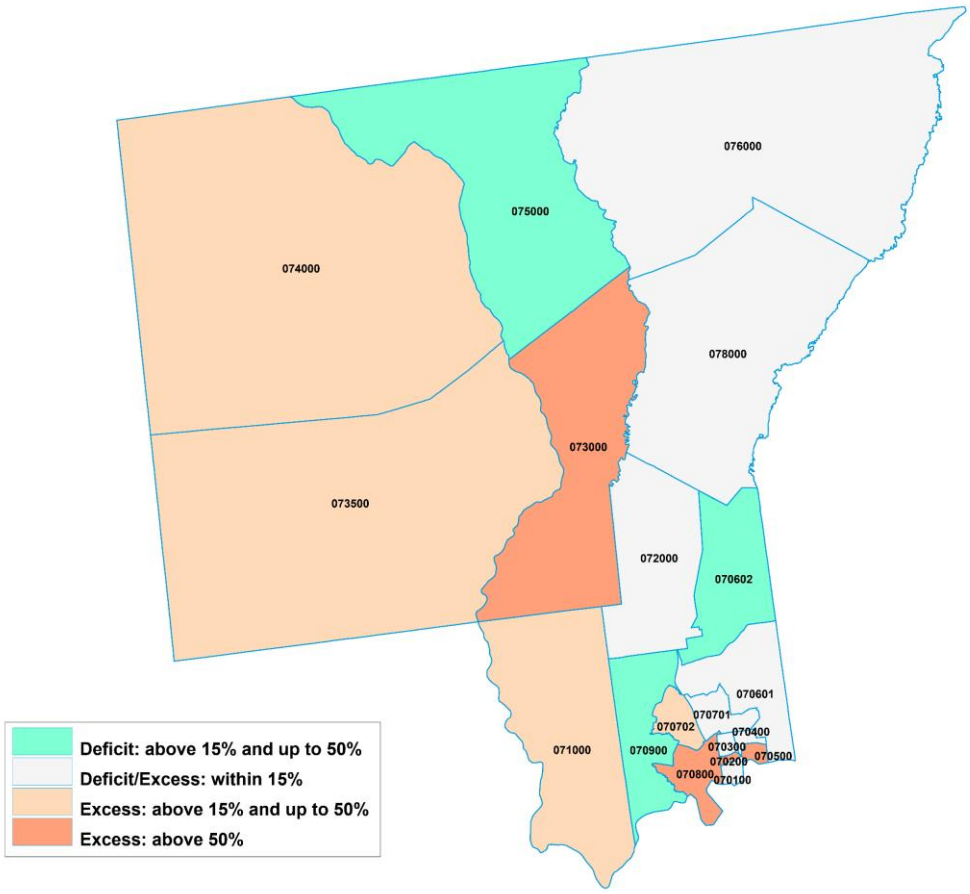
[1] Incidence rate (per 100,000 persons) was age-adjusted to the 2000 US standard population.

** The rate for Warren County is statistically different from the rate for NYS excl. NYC at p<0.05 level.*

Table 9-3 Distribution (%) of Reported Tobacco Use among Lung Cancer Cases by Subtype for Warren County, 2011-2015

Tobacco Use	Small cell lung cancer	Non-small cell lung cancer		
		Squamous cell carcinoma	Adenocarcinoma	Large cell carcinoma
Current	46.7	44.2	42.4	43.8
Prior	31.7	47.7	43.2	45.8
Never	1.7	2.3	7.9	8.3
Unknown	20.0	5.8	6.5	2.1

Figure 9-3 Excess or Deficit[1] of Lung Cancer Incidence by Census Tract for Warren County, 2011-2015



[1] Excess or deficit is defined as the relative difference of the observed number of lung cancer cases versus the expected number of cases. The expected number of cancer cases is the number of cases one would expect to find, if the incidence rate in Warren County were the same as in NYS excluding NYC.

tracts in Warren County, only in four census tracts (tract numbers 070200, 070500, 070800, and 073000) were the numbers of observed cases higher than the numbers expected by 50% or more. The elevation was statistically significant only in census tracts 070500, 070800, and 073000, cumulatively accounting for 74% of the overall excess in Warren County between 2011 and 2015. Due to the lack of past exposure information at the census tract level, no further tract-level analysis was carried out.

Discussion

In general, the incidence of lung cancer in Warren County has been higher than that in NYS excluding NYC for two decades (Fig. 9-1). The marked excess of lung cancer in Warren County in the 2011-2015 period was primarily driven by a substantial decrease of incidence in NYS

excluding NYC, not by a large increase in Warren County. A series of stratification analyses showed that the excess was mainly associated with men and adults under age 65. It is somewhat concerning that, for the three adult age groups examined, the magnitude of elevation was largest for the youngest group (20-49) (Table 9-1). As the current population ages, the disparities in lung cancer incidence between Warren County and NYS excluding NYC might become larger.

Rates of the three major subtypes of lung cancer that are strongly associated with smoking were significantly elevated (Table 9-2). An overwhelming majority of lung cancer patients in Warren County had a history of tobacco use at some time in their life. The proportion of patients who never consumed tobacco products was lower among those diagnosed with small cell carcinoma and squamous cell carcinoma, the two subtypes most strongly related to cigarette smoking (Table 9-3). These findings are consistent with smoking as the key risk factor for lung cancer. The observed excess in lung cancer would be expected to reflect a higher prevalence of cigarette smoking in Warren County 20 to 30 years ago. Unfortunately, we have no smoking prevalence data for that time. The earliest data available come from the 2003 e-BRFSS. It suggests that the proportion of "current" smokers in Warren County was higher than in NYS excluding NYC at the time when the survey was administered.[15]

Although lung cancer incidence among females in Warren County was not statistically significantly elevated relative to NYS excluding NYC, the current higher smoking prevalence among females in Warren County suggests that the relative difference in female lung cancer rates might become larger.

Specific air pollutants as well as urban air pollution in general have been associated with lung cancer. Review of the 2011 and 2014 NATA data indicated that for most of the HAPs that are known or probable carcinogens the estimated cancer risk was extremely small (i.e., less than one-in-one-million) for both Warren County and NYS excluding NYC. These HAPs included beryllium compounds, chromium VI (hexavalent), cadmium compounds, and arsenic compounds (inorganic including arsine). Cancer risk associated with levels of 1,3-butadiene, acetaldehyde, benzene, carbon tetrachloride and formaldehyde were above one-in-one-million, but were lower or similar to levels in NYS excluding NYC (Tables 4-1 & 4-2). In addition, the proportion of residents who live in proximity to high traffic roads was lower in Warren County than in NYS excluding NYC (Table 4-7). Therefore, available data on outdoor air quality indicate that air pollution is unlikely to explain the elevated lung cancer rates in Warren County.

As mentioned in the "Environmental Data Review" section, residential wood combustion accounts for 90% or more of carbonaceous fine particulate (i.e., $PM_{2.5}$) emissions in rural NYS counties. Therefore, exposure to wood smoke poses a potential risk for developing lung cancer among residents of Warren County, especially in areas with poor dispersion of pollutants. Due to the lack of individual-level exposure data, this study was unable to assess whether residential wood combustion contributed to the excess of lung cancer in Warren County.

Radon is an important environmental risk factor for lung cancer. Results of radon tests

conducted between 1987 and 2015 indicate that radon levels in Warren County were generally lower than in NYS excluding NYC (Table 4-3 & Fig. 4-1). Although radon may be contributing to lung cancer risk in a limited number of localities, it is unlikely to explain the lung cancer excess in Warren County.

Although exposure to most of the substances that have been associated with lung cancer occurs by inhalation, elevated lung cancer rates have also been seen in communities with high levels of arsenic in drinking water, and ingestion of metals is a potential additional exposure pathway. Routine testing of public water supplies includes testing for a wide variety of organic and inorganic substances. Detections and exceedances for arsenic, as well as beryllium, cadmium, and nickel – chemicals also associated with lung cancer risk, were also reviewed for public water systems in Warren County. None of these substances were detected at levels above the applicable standards except for nickel, which was found to exceed the standard in one sample among hundreds of samples tested between 1999 and 2015. The substances for which water violations were issued (i.e., total trihalomethanes and total haloacetic acids) have not been associated with lung cancer.

One study found that about 21% of lung cancers in men and 4% in women were attributable to occupational exposures.[16] Warren County has a greater proportion of people working in occupations with a higher probability of workplace exposures to elevated levels of hazardous substances than NYS excluding NYC. Elevated exposures to various cancer-causing substances in the workplace are likely to occur in in these types of occupations, although the particular exposures would differ for different occupations and possibly even workplaces. There were insufficient data available to evaluate the possible contributions of specific occupations to the lung cancer excess in Warren County. Examination of asbestosis hospitalization rates, a proxy for exposure to asbestos, found no difference in hospitalization rates between Warren County and NYS excluding NYC (Table 3-5). Therefore, it is unlikely that the excess of lung cancer in Warren County is due to occupational exposure to asbestos.

10. Melanoma of the Skin

Overview

Melanoma represents about 1% of skin cancers, but it accounts for most skin cancer deaths.[1] The American Cancer Society estimates than 9,000 people in the United States will die from melanoma in 2018. The number of new cases has increased steadily over the last 30 years.

Risk Factors

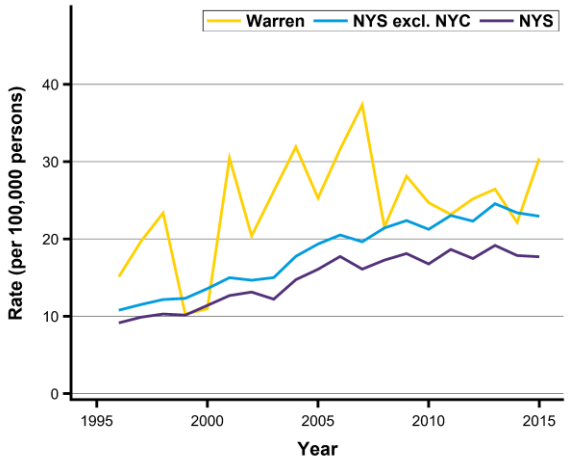
Ultraviolet (UV) radiation is believed to be the most important risk factor and is estimated to account for 90% of all cases.[2] Most exposure to UV radiation is from sunlight, but frequent use of indoor tanning beds also increases the risk of melanoma.[3] Unlike other types of skin cancer, intermittent sunburns may be more important than lifetime exposure to UV radiation,[4] especially sunburns during childhood and adolescence.[5] People who are sensitive to the sun, such as those with light complexions, blue eyes, and red hair, are at higher risk,[6] as are those with large, unusual, or numerous moles or birthmarks.[7]

Findings

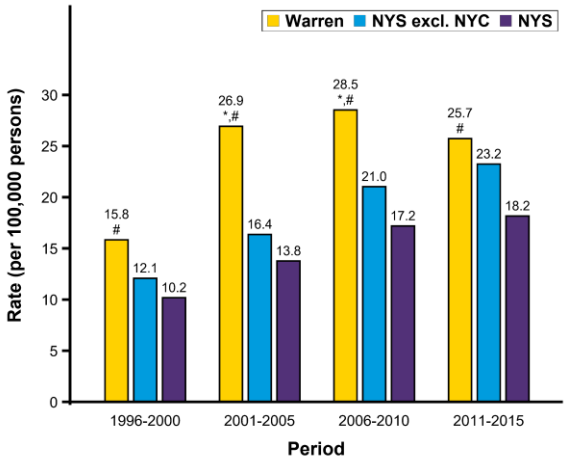
Historically, the age-adjusted incidence rate of melanoma of the skin for Warren County has been higher than the rates for NYS and NYS excluding NYC (Fig. 10-1). The rate has been stable

Figure 10-1 Incidence Rate[1] of Melanoma of the Skin for Warren County, New York State excluding New York City, and New York State, 1996-2015

(A) Annual Rate



(B) 5-year Average Rate



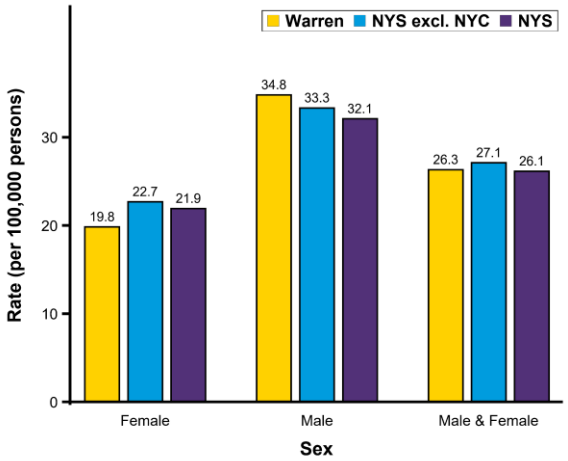
[1] Incidence rate was age-adjusted to the 2000 US standard population.

** The rate for Warren County is statistically different from the rate for NYS excl. NYC at p<0.05 level.*

[#] The rate for Warren County is statistically different from the rate for NYS at p<0.05 level.

in the past decade, with a slight hint of a decline in recent years. The rates for Warren County and for NYS excluding NYC have become similar in recent years; for the 2011-2015 period, the incidence rates for Warren County (25.7 per 100,000 persons) and NYS excluding NYC (23.2 per 100,000 persons) were statistically comparable. Rates in Warren County have remained significantly higher than those for NYS; in 2011-2015 the difference was about 42% (Table A-II-1 in Appendix II).

Figure 10-2 Incidence Rates[1] of Melanoma of the Skin among non-Hispanic Whites by Sex, Warren County, New York State excluding New York City, and New York State, 2011-2015

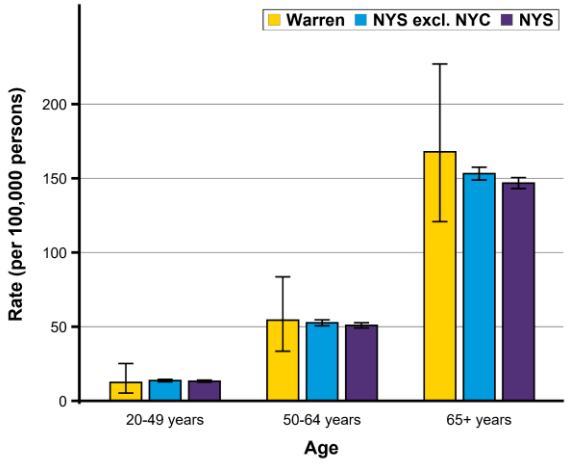


[1] Incidence rate was age-adjusted to the 2000 US standard population.

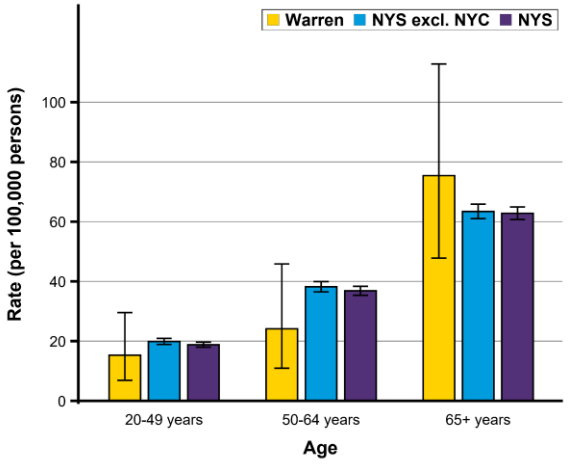
Of the 115 cases diagnosed in Warren County between 2011 and 2015, 114 were non-Hispanic white; the remaining case was non-Hispanic of unknown race. The incidence rate for non-Hispanic whites was 26.3 per 100,000 persons, 34.8 for males and 19.8 for females (Fig. 10-2). There were no statistical differences in the overall or sex-specific incidence rates between Warren County and either NYS excluding NYC or NYS. There were also no statistical differences for each of three age groups examined (Fig. 10-3).

Figure 10-3 Incidence[1] Rates of Melanoma of the Skin (with 95% Confidence Intervals) among non-Hispanic Whites by Sex and Age Group, Warren County, New York State excluding New York City, and New York State, 2011-2015

(A) Male



(B) Female



[1] Incidence rate was age-adjusted to the 2000 US standard population.

Discussion

One major non-modifiable risk factor for melanoma is having a light complexion, a biological trait common among whites. When analyzing melanoma of the skin, it is therefore appropriate to compare people of the same racial and ethnicity group. When this is done, melanoma rates in Warren County are not unusual compared with either NYS excluding NYC or NYS. The rates of melanoma in Warren County are elevated because Warren County residents are almost exclusively non-Hispanic white (95%), while only 76% of the population of NYS excluding NYC and 58% of the population of NYS are non-Hispanic white (Table 3-1).

11. Cancers of the Brain and Other Nervous System (ONS)

Overview

Included in this category are cancers of the brain and other nervous system (ONS), including cranial nerves (e.g., optic nerve); meninges, the layers of tissue that surround the brain and spinal cord; and the spinal cord itself. Of the cancers in this category, 92.7% are cancers of the brain. Cancer statistics are based on tumors that are malignant (i.e., cancerous). Beginning in 2004, reporting of benign intracranial and central nervous system (CNS) tumors became nationally mandated. These benign tumors are not routinely included in cancer statistics. In the period 2011-2015, there were about 2.2 times as many benign tumors of the brain and ONS as there were malignant tumors in New York State. Most benign tumors (70.0%) are tumors of the meninges; only 10.4% are brain tumors.

Risk Factors

Most of the available risk factor information focuses on cancer of the brain. Brain cancers are relatively rare but serious, with an average five-year survival rate of only 35%.[1] Although, in general, rates of this cancer increase with age, some types of brain cancer occur among children and adolescents.[2] Relatively little is known about the causes of brain cancer. Certain hereditary conditions are known to increase risk, but these genetic disorders are rare.[3] The only other established risk factor is exposure to ionizing radiation of the head, for example from treatments for other cancers.[4] Non-ionizing radiation has also been investigated, including exposure to electromagnetic fields (EMF) from mobile phones.[5] In general, the results of these studies do not support an association with brain cancer,[6] but research in this area is ongoing. Workers exposed to EMF have also been studied, and there is no clear evidence that they are at higher risk.[7] Possible associations between brain cancers and occupational exposures such as pesticides and solvents have been studied extensively, but the results are inconclusive.[8] Allergic conditions such as asthma, hay fever, and eczema, however, may reduce the risk of brain cancer.[9]

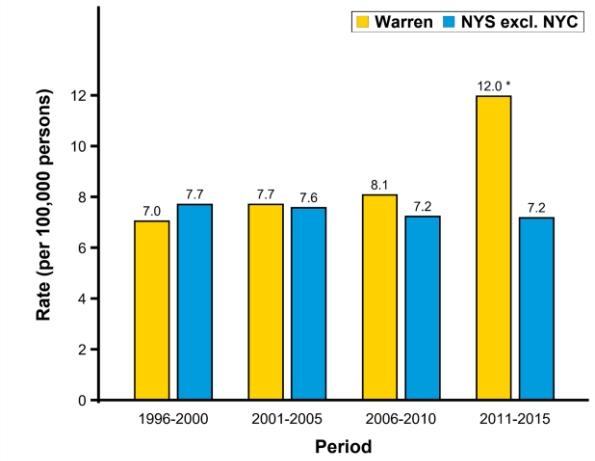
Findings

The incidence of cancers of the brain and ONS in Warren County did not differ significantly from the incidence in NYS excluding NYC until the 2011-2015 period (Fig. 11-1(A)). During that period, there were 44 cancers of the brain and ONS system in Warren County, 19 among males and 25 among females. The incidence was 66.7% higher relative to NYS excluding NYC (12.0 vs. 7.2 per 100,000). However, as seen in Figure 11-1(B), incidence rates fluctuate to a large degree annually. Thus the 2011-2015 period may represent an anomaly.

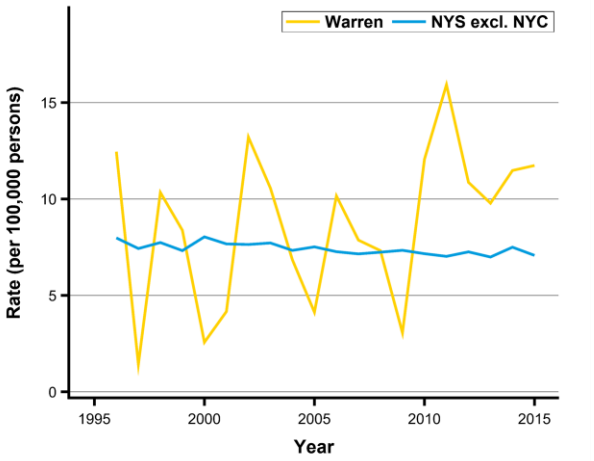
For the 2011-2015 period, the rate among females in Warren County was 114.5% higher (13.3 vs. 6.2 per 100,000), a statistically significant difference; while the rate for males was 30.1% higher (10.8 vs. 8.3 per 100,000) and not statistically different (Fig. 11-2).

Figure 11-1 Incidence Rates[1] of Brain and Other Nervous System Cancers for Warren County and New York State excluding New York City, 1996-2015

(A) 5-year Average Rate



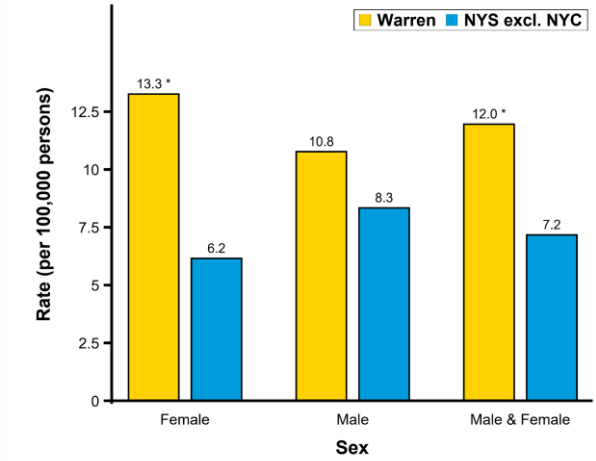
(B) Annual Rate



[1] *Rates are per 100,000 persons, age-adjusted to the 2000 U.S. standard population.*

** The rate for Warren County is statistically different from the rate for NYS excl. NYC at p<0.05 level.*

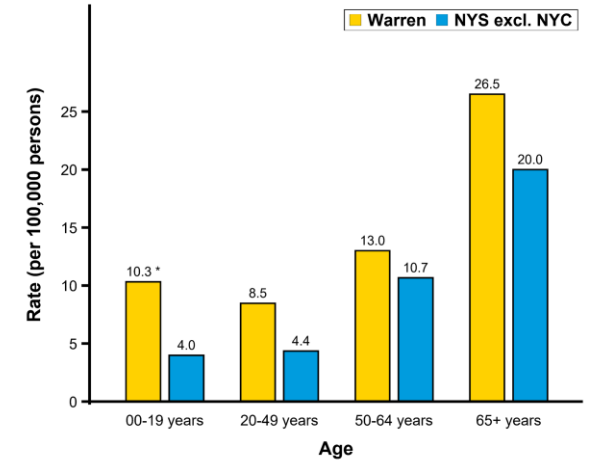
Figure 11-2 Incidence Rates[1] of Brain and Other Nervous System Cancers by Sex, Warren County and New York State excluding New York City, 2011-2015



[1] *Rates are per 100,000 persons, age-adjusted to the 2000 U.S. standard population.*

** The rate for Warren County is statistically different from the rate for NYS excl. NYC at p<0.05 level.*

Figure 11-3 Incidence Rates[1] of Brain and Other Nervous System Cancers by Age, Warren County and New York State excluding New York City, 2011-2015



[1] *Rates are per 100,000 persons, age-adjusted within the age-categories to the 2000 U.S. standard population.*

** The rate for Warren County is statistically different from the rate for NYS excl. NYC at p<0.05 level.*

When looking at males and females combined, rates for Warren County were elevated for all age categories, but the elevation was only statistically significant among persons under age 20 (Fig. 11-3). Among females, rates were also elevated for all age categories; whereas for males, rates were only elevated in the two younger age categories (i.e., 0-19 and 20-49). Due to small numbers, none of the elevations were statistically significant when stratifying by sex and age.

Examination by cell type revealed an excess in pilocytic astrocytomas in Warren County relative to NYS excluding NYC (13.6% vs. 5.3% of brain and ONS cancers). Pilocytic astrocytomas tend to occur more often in children and young adults. The incidence rate of pilocytic astrocytomas among individuals 0-19 years of age in Warren County was 4.8 times higher than the comparable rate for NYS excluding NYC (5.8 vs. 1.2 per 100,000), a statistically significant difference. The rate among 20-49-year-old individuals was also elevated (1.6 vs. 0.3 per 100,000) but the elevation was not statistically significant. In total, there were six pilocytic astrocytomas diagnosed among individuals under 50 years of age. Additional analyses indicate that 75% of the excess in brain and ONS cancers observed for individuals under 20 years of age in Warren County can be attributed to pilocytic astrocytomas.

No other unusual patterns were observed by cell type. Glioblastomas comprised 54.5% and 53.7% of brain and ONS cancers in Warren County and NYS excluding NYC, respectively.

Since tumors of benign or uncertain behavior occurring in the brain and ONS nervous system have been reportable nationally since 2004, we examined incidence trends by behavior (benign, uncertain, or malignant). The incidence rate of tumors of the brain and ONS of benign or uncertain behavior was lower than the rate of malignant tumors in Warren County during 2011-2015 (Table 11-1). The benign to malignant rate ratio was below one and differed statistically from the rate ratio for NYS excluding NYC. Because of the unusual pattern by tumor behavior, we manually reviewed all reported cases to ensure that behavior was coded correctly. That is, we wanted to rule out the possibility that some benign tumors were being miscoded as

Table 11-1 Age-adjusted Incidence Rates[1] of Brain and Other Nervous System Tumors by Behavior (Benign or Uncertain versus Malignant) and Time Period, Warren County and New York State excluding New York City, 2006-2015

Time Period	Warren County			NYS excl. NYC		
	Rate of Benign Tumors	Rate of Malignant Tumors	Benign to Malignant Rate Ratio	Rate of Benign Tumors	Rate of Malignant Tumors	Benign to Malignant Rate Ratio
2006-2010	13.0	8.1	1.6	13.4	7.2	1.9
2011-2015	10.5	12.0	0.9 *	14.1	7.2	2.0

[1] Rates are per 100,000 persons, age-adjusted to the 2000 US standard population.

** The benign to malignant rate ratio for Warren County is statistically different from the rate ratio for NYS excluding NYC at p<0.05 level.*

malignant and artificially inflating the cancer incidence rate. Our review of the data did not identify errors in the behavior code that was reported to the Registry.

Because radiation exposure is a risk factor for cancer of the brain and ONS nervous system and cancer patients are frequently treated with radiation, we looked at the proportion of patients who had a prior history of cancer. We found that the prevalence of prior cancers among individuals with cancers of the brain or ONS was similar in Warren County and NYS excluding NYC (11.4% vs. 13.5%). Thus, it is unlikely that a sizeable proportion of the excess incidence of brain and ONS cancer in Warren County can be attributed to radiation treatment for a prior cancer.

Discussion

The elevation in the incidence of cancers of the brain and other nervous system observed in Warren County was limited to the 2011-2015 period and mostly to females. In fact, 80% of the overall excess can be attributed to an excess among females. Since there were only 44 cases in the five-year period, all findings based on stratified analyses must be interpreted with caution.

We did find an elevation in pilocytic astrocytoma tumors. These tumors are classified as non-malignant by the World Health Organization[10] but in the United States are included among malignant tumors of the brain and central nervous system by convention. The exact underlying cause of pilocytic astrocytomas is currently unknown. Although most occur in individuals with no underlying genetic condition, they are known to be associated with certain genetic disorders including neurofibromatosis type I, Li-Fraumeni syndrome, and tuberous sclerosis.[11] Pilocytic astrocytomas usually grow slowly and 10-year survival rates are greater than 90% in pediatric patients; however, they are poorer in adults. Tumors that can be removed completely through surgery have the best overall survival.[12]

The only well-established environmental risk factor for brain cancer is exposure to moderate to high levels of ionizing radiation, such as those experienced by atomic bomb survivors in Japan, or from radiation treatment for other cancers, or from radiation treatments to the head, an historical treatment for ringworm.[13] Since the proportion of individuals with cancers of the brain and ONS who had a history of a prior cancer was similar in Warren County and NYS excluding NYC, therapeutic radiation exposure cannot account for the observed excess in Warren County.

Recent studies have focused on whether the use of computed tomography (CT) scans increases the risk of developing cancers of the brain.[13] Some studies suggest that children who had CT scans are at increased risk of cancer,[14] including brain cancer specifically.[14,15] A study based on data from 2007 and restricted to inpatients, found that after adjusting for patient and hospital characteristics, prevalence of CT scan use in Warren County was close to the average for the state.[16]

We cannot explain the excess of brain and ONS cancers observed among females in Warren County for 2011-2015. We also cannot explain why incidence rates would be elevated in females but not in males. Given the variability in rates for Warren County and the unusual pattern by sex, we cannot rule out a statistical anomaly. Examination of data for 2012-2016 indicate that the incidence of brain and ONS cancers in Warren County remained elevated compared to NYS excluding NYC, although the relative excess declined from 66.7% to 42.2% for males and females combined, from 30.1% to 15.7% for males, and from 114.5% to 80.0% for females.

12. Thyroid Cancer

Overview

Thyroid cancer is the most common endocrine-related cancer. An ultrasound of the thyroid gland and a fine-needle aspiration biopsy are standard tests to diagnose and assess the primary tumor. It occurs more frequently in women than in men (e.g., at an approximate ratio of 3:1).[1] Patient's age, tumor size, and histological grade are important factors for prognosis. In particular, thyroid cancer can occur at any age, though it becomes more common among those aged 30 years and older.[2] In general, there are four specified subtypes of thyroid cancers based on the histology, i.e., how the cancer cells appear under a microscope. Papillary carcinoma is the most common and the least aggressive subtype, followed by follicular carcinoma, medullary carcinoma, and anaplastic carcinoma. In the past several decades, the increase in thyroid cancer incidence in the U.S. has been driven by an increase in papillary carcinoma.[3] Because most thyroid cancers are papillary or follicular carcinomas, they are easily treatable and highly curable. Anaplastic carcinoma, though very rare, is the most aggressive and lethal, and thus the major contributor to thyroid cancer mortality.[4]

Risk Factors

Many recent studies and review articles have concluded that the primary risk factor for thyroid cancer is the medical system itself – specifically, receiving a neck ultrasound or other form of imaging in the absence of any symptoms or expectation of future symptoms.[5-7] In other words, these tests are detecting cases of thyroid cancer that would have been undiagnosed in the past. The next most important modifiable risk factor for thyroid cancer is exposure to ionizing radiation,[8,9] particularly at a young age.[10-12] Sources of ionizing radiation exposure include medical procedures such as x-rays[13,14] and CT scans,[10,13] radiation treatment for a previous cancer,[15] emissions from nuclear accidents, [11,16] and fallout from above-ground nuclear weapons testing.[9,17] There is also evidence that a diet low in iodine is associated with increased risk of the follicular subtype of thyroid cancer.[18] In addition, excess body fat is associated with thyroid cancer, although the increase in thyroid cancer risk is modest.[19,20]

Non-modifiable risk factors for thyroid cancer include hereditary conditions such as mutations in the RET gene,[21,22] familial adenomatous polyposis,[23,24] Cowden disease,[23-25] and Carney complex type I.[23,24] Familial non-medullary thyroid carcinoma[26] and a family history of thyroid cancer[27] also increase the risk, although family history is itself entwined with overdiagnosis: family members of those who have been diagnosed through medical imaging are themselves more likely to request or be recommended for the same imaging.[6,27,28]

Findings

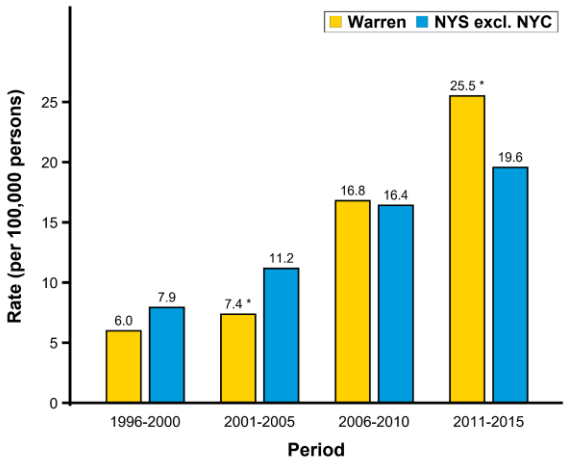
Thyroid cancer incidence rates for Warren County as well as for NYS excluding NYC have been increasing for decades (Fig. 12-1). For the 1996-2000 and 2001-2005 periods, thyroid cancer

rates for Warren County were 25% and 34% lower than rates for NYS excluding NYC, respectively. Between 2001-2005 and 2006-2010, the incidence rate for Warren County more than doubled, reaching the rate for NYS excluding NYC. The rate in Warren County continued to grow faster than the rate for NYS excluding NYC, so that in 2011-2015 it was 30% higher. By that time period, Warren County also ranked 3rd among all NYS counties in thyroid cancer incidence, following Richmond County and Putnam County.

For 2011-2015, the elevated rate for Warren County was primarily driven by women. During this period, the rate among females was 37% higher than the rate for NYS excluding NYC, that is 39.2 vs. 28.6 per 100,000 persons (Table A-II-3 in Appendix II). And the excess was statistically significant. The rate for males was only 7% higher (i.e., 11.0 vs. 10.3 per 100,000 persons) and not statistically significant (Table A-II-2). Because the excess of thyroid cancer was primarily among females, the female to male rate ratio for Warren County (3.6) was considerably higher than that for NYS excluding NYC (2.8).

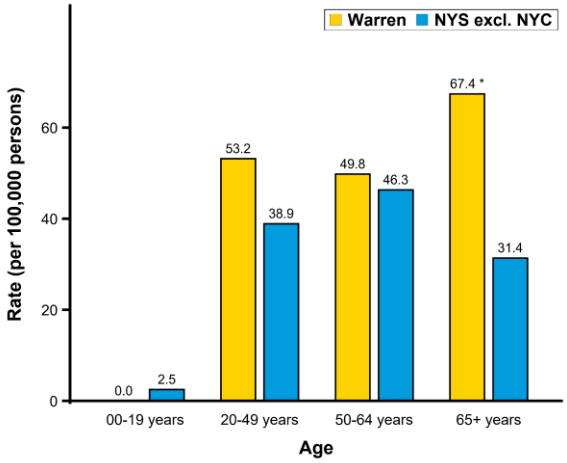
Focusing specifically on women, the average age at thyroid cancer diagnosis for females in Warren County in the 2011-2015 period was 54 years (with a standard deviation of 17 years), about five years older compared to the 49 years for females in NYS excluding NYC. Rates were elevated in all adult age categories, but the elevation was only statistically significant among females aged 65 years or older (Fig. 12-2). While thyroid cancer rates in NYS excluding NYC peaked in middle-aged females (i.e., those aged 50-64 years old), elderly females in Warren County had the highest rates.

Figure 12-1 Thyroid Cancer Incidence Rates[1] by Time Period, Warren County and New York State excluding New York City, 1996-2015



[1] Incidence rate was age-adjusted to the 2000 US standard population.
** The rate for Warren County is statistically different from the rate for NYS excl. NYC at p<0.05 level.*

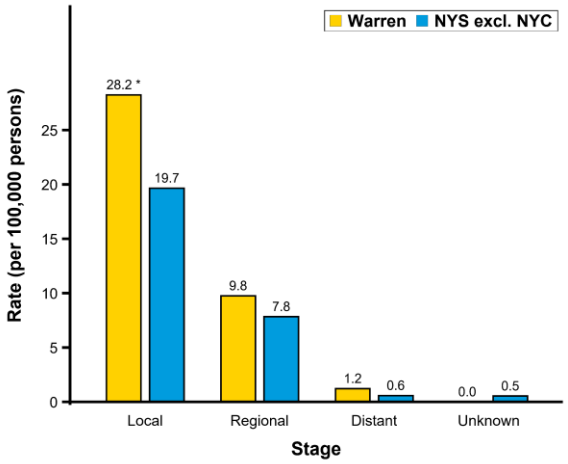
Figure 12-2 Female Thyroid Cancer Incidence Rates[1] by Age Group, Warren County and New York State excluding New York City, 2011-2015



[1] Incidence rate was age-adjusted to the 2000 US standard population.
** The rate for Warren County is statistically different from the rate for NYS excl. NYC at p<0.05 level.*

Most female thyroid cancers were diagnosed at a localized stage both in Warren County (75%) and in NYS excluding NYC (69%). The incidence rate for localized thyroid cancer was 44% higher in Warren County than in NYS excluding NYC (Fig. 12-3). Rates for regional- and distant-stage tumors were comparable. Approximately 80% of the excess in female thyroid cancer in Warren County can be attributed to an increase in localized thyroid cancer.

Figure 12-3 Female Thyroid Cancer Incidence Rates[1] by Stage at Diagnosis, Warren County, and New York State excluding New York City, 2011-2015

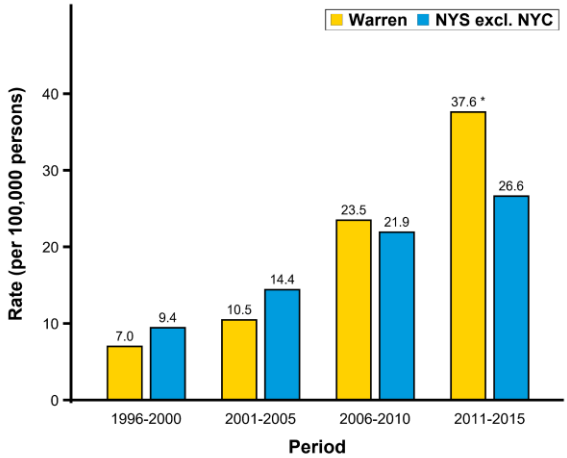


[1] Incidence rate was age-adjusted to the 2000 US standard population.
** The rate for Warren County is statistically different from the rate for NYS excl. NYC at p<0.05 level.*

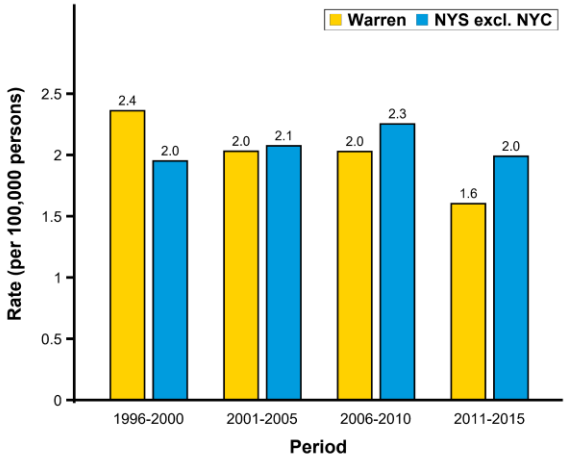
Regarding thyroid cancer subtypes, papillary carcinomas comprised about 96% and 92% of female cases in Warren County and NYS excluding NYC, respectively. Follicular carcinomas comprised a further 4% and 5%. Medullary and anaplastic carcinomas, two rare but important subtypes, accounted for approximately 1% and 0.5% in NYS excluding NYC. The incidence of papillary carcinoma among females in Warren County increased by more than 5-fold between 1996-2000 and 2011-2015 from 7.0 to 37.6 per 100,000 persons, while the increase in NYS excluding NYC was less than 3-fold (Fig. 12-4). The incidence rates for all other tumor subtypes combined (i.e., non-papillary) only varied moderately for both areas

Figure 12-4 Female Thyroid Cancer Incidence Rates[1] by Time Period and Subtype, Warren County and New York State excluding New York City, 1996-2015

(A) Papillary



(B) Non-papillary



[1] Incidence rate was age-adjusted to the 2000 US standard population.
** The rate for Warren County is statistically different from the rate for NYS excl. NYC at p<0.05 level.*

over the same 20-year span, and incidence rates for the two areas were comparable in each 5-year period. Since the entire female thyroid cancer excess in Warren County, relative to NYS excluding NYC, was driven by the increase in the incidence of papillary carcinomas, further examination by tumor size was limited to papillary carcinomas.

The NYS Cancer Registry did not systematically collect information on tumor size for cancer cases diagnosed prior to 2004. In 2006-2010, female papillary carcinoma incidence rates by tumor size were comparable in Warren County and NYS excluding NYC (Fig. 12-5). From 2011 through 2015, female papillary carcinoma incidence rates were highest for tumors less than or equal to 1 cm in size in both areas, with the rate for Warren County exceeding the rate for NYS excluding NYC by 57%. At least 90% of the excess in papillary thyroid cancer incidence among females in Warren County was due to small tumors of 2 cm or less.

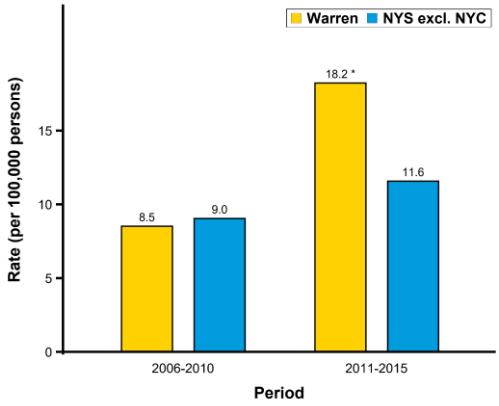
Because radiation exposure is a risk factor for thyroid cancer and cancer patients are frequently treated with radiation, we looked at the proportion of female thyroid cancer patients who had a prior history of cancer. We found that the prevalence of prior cancers in Warren County and NYS excluding NYC did not differ substantially (18% vs. 12%). Thus, it is unlikely that a sizeable proportion of the excess in female thyroid cancer incidence in Warren County can be attributed to radiation treatment for a prior cancer.

Discussion

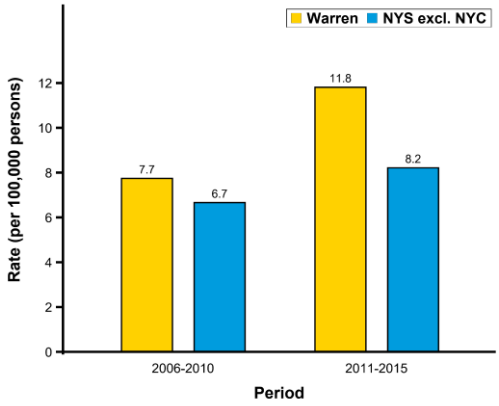
Our review of thyroid cancer incidence in Warren County compared to NYS excluding

Figure 12-5 Female Thyroid Papillary Carcinoma Incidence Rates[1] by Time Period and Tumor Size, Warren County and New York State excluding New York City, 2006-2015

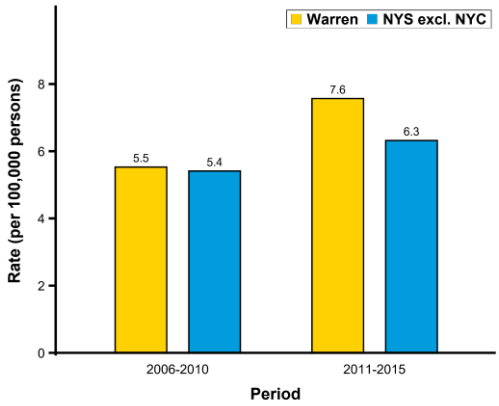
(A) 0-1.0 cm



(B) 1.1-2.0 cm



(C) 2.1+ cm



[1] Incidence rate was age-adjusted to the 2000 US standard population.
** The rate for Warren County is statistically different from the rate for NYS excl. NYC at p<0.05 level.*

NYC demonstrates that the excess observed between 2011 and 2015 is mainly attributable to the increased diagnosis of small papillary carcinomas. Tumors of this type and size meet the formal definition of overdiagnosis: asymptomatic, subclinical, and unlikely to progress. The increase in incidence in NYS excluding NYC is consistent with national and international observations of this same phenomenon.[29-31] A recent study published in the New England Journal of Medicine estimated that 70%-80% of female thyroid cancer cases and 45% of male thyroid cases in the United States represented overdiagnosis.[5]

This increase in overdiagnoses motivated the American Thyroid Association to announce that certain thyroid cancers would no longer be classified as such. Beginning with cases diagnosed in 2017, encapsulated follicular variant papillary thyroid carcinomas without capsular or vascular invasion have been reclassified as noninvasive follicular thyroid neoplasm with papillary-like nuclear features.[32] This means that some of the thyroid cancers described in this report would not have been counted if they had been diagnosed in 2017 or later. The exact impact of this revised classification on future thyroid cancer statistics remains to be seen but should result in a reduction in rates.

Since virtually all overdiagnosed thyroid cancers are found incidentally through ultrasound or other imaging techniques, elevated thyroid cancer rates tend to be found in areas where more medical imaging is performed, which corresponds with areas that have more healthcare utilization generally.[33-38] The combined 2013-2014 and 2016 e-BRFSS data show a greater proportion of adults in Warren County had health care coverage than those in NYS excluding NYC (Table 3-2). In recent years, Warren County has had one of the highest “Clinical Care Factors” – a composite metric of access to care and quality of care - among New York State counties (Table 3-4). Thus, high healthcare utilization in Warren County may be contributing to higher thyroid cancer rates.

Adult females in Warren County had higher body mass indexes (BMIs) compared to those in NYC excluding NYC during the 2011-2015 period (Table 3-2 & Fig. 3-2), which also could have contributed to the thyroid cancer excess. However, given that this effect is very modest – an increased risk of 4% for every 5 units of BMI[39] - its contribution would be minor. It is possible that the risk pathway here is less related to the excess weight itself, and more related to increased interactions with the health care system due to poorer health generally.[40,41]

13. Leukemia

Leukemias are cancers of the blood cells. There are four major types of leukemia, distinguished by how quickly the disease progresses (acute vs. chronic), and the type or types of blood cells affected. The different leukemias have somewhat different, but overlapping, sets of risk factors. The four major types of leukemia and their risk factors are discussed separately below.

Risk Factors

Acute lymphocytic leukemia (ALL) starts in cells that become lymphocytes, a type of white blood cell. It differs from chronic lymphocytic leukemia (CLL) in that more of the abnormal cells are immature, and it progresses more rapidly. ALL is the most common type of leukemia in children but also affects adults, especially those 65 years of age or older.[1] Childhood ALL is associated with certain genetic conditions such as Down syndrome.[2] Ionizing radiation, including exposure of the mother while pregnant, increases the risk of ALL.[3] Some early studies suggested an increased risk from non-ionizing radiation such as electromagnetic fields,[4] but more recent studies indicate that this may only be when the strength of the fields is very high.[5] High birthweight (usually defined as >4,000 g/8 lbs. 13 oz.) is a risk factor for childhood ALL.[6] Children with allergies may be at lower risk,[7] and some studies have suggested that childhood infections are involved, but no specific virus has been identified.[8] Parental smoking, alcohol consumption, and diet have also been investigated as risk factors for childhood ALL, but the results are inconclusive.[9] In regard to chemical exposures, some studies have linked maternal occupational exposures to hydrocarbons[10] and other chemicals[11] to childhood ALL. There is also evidence to suggest that both child and parental exposures to insecticides may increase the risk of childhood ALL.[12] Numerous studies have examined exposure to air pollution from motor vehicle exhaust and childhood ALL, but the findings are inconsistent.[13,14]

Regarding adult ALL, employment in industries related to petroleum, rubber, automobile manufacturing, nuclear energy, electronics, munitions, dye manufacturing, and plastics may increase the risk.[15] Some studies have also linked the use of hair dyes to ALL in adults, but the results are inconsistent.[16] A rare type of ALL called adult T-cell leukemia is caused by the HTLV-1 virus, but this virus is extremely uncommon in the United States.[17]

Acute myeloid leukemia (AML) most often develops from cells that would turn into white blood cells (other than lymphocytes), but sometimes develops in other types of blood-forming cells. It differs from chronic myeloid leukemia (CML) in that more of the abnormal cells are immature, and it progresses more rapidly. AML is the second most common form of leukemia in adults, but also affects children and adolescents.[1] Among children, genetic disorders such as Down syndrome are important risk factors for AML.[18] Ionizing radiation such as maternal X-ray exposure while pregnant is a well-established cause of childhood AML.[3] Studies suggest an increased risk with older maternal age[19] but not with paternal age.[20] There is also some evidence of an increased risk with increasing birth order,[21] but this could be due at least in part to maternal age. Overall, there appears to be an increased risk of childhood AML with prior

pregnancy loss.[22] Maternal alcohol use during pregnancy may be a risk factor,[23] but maternal smoking does not appear to have an effect.[24] Maternal occupational exposure to pesticides is associated with increased risk but paternal exposure is not.[25] Children who were breast-fed for six months or more may be at lower risk of AML.[26]

Ionizing radiation is also a well-established cause of AML in adults,[27] as are several drugs used in chemotherapy.[28] Occupational exposure to benzene is a risk factor,[29] and persons occupationally exposed to embalming fluids, ethylene oxides, and herbicides also appear to be at increased risk.[30] Smoking is another risk factor – in fact, 15% of all cases of adult AML may be due to smoking.[31] An additional lifestyle risk factor is obesity, with obese persons having twice the risk of developing AML as those who are not obese.[32] An association between viruses and AML has been suggested but no specific viruses have been identified.[30]

Chronic lymphocytic leukemia (CLL) starts in cells that become lymphocytes, a type of white blood cell. It differs from acute lymphocytic leukemia (ALL) in that more of the abnormal cells are partly mature and partly functional, and it progresses more slowly. CLL is the most common type of leukemia in adults, but rarely affects children.[1] Family history is a strong risk factor,[33] but other causes of CLL are uncertain. For example, ionizing radiation is a well-established risk factor for most types of leukemia, but the evidence for CLL is mixed.[34] Early studies suggested that occupational exposures to non-ionizing forms of radiation such as electromagnetic fields increase the risk of CLL,[35] but later studies indicate that the association is weak and not conclusive.[36] Occupational exposure to chemicals such as benzene, ethylene oxide, 1-3 butadiene, and pesticides have been linked to CLL in some studies, but the findings are not consistent.[37] Autoimmune and allergic diseases do not appear to increase the risk of CLL,[38] but some studies suggest that pneumonia may be a risk factor.[39] There is little evidence that lifestyle factors such as smoking[40] and diet[41] are important in developing CLL.

Chronic myeloid leukemia (CML) is also known as chronic myelogenous leukemia. It is a cancer of myeloid cells, the cells that make most types of white blood cells (other than lymphocytes), red blood cells, and cells that make platelets. It differs from acute myeloid leukemia (AML) in that more of the abnormal cells are partly mature and partly functional, and it progresses more slowly. CML, rare in children and adolescents, is most commonly diagnosed among adults 65 years of age and older.[42] Ionizing radiation is believed to be a risk factor,[43] but otherwise the causes of CML are poorly understood.[44] There is some evidence that smoking may increase the risk of CML,[45] but the association is not as strong as it is for AML. Family history does not appear to be important,[46] nor does alcohol consumption.[47] Certain types of chemotherapy may increase the risk of CML, but this is rare.[48] Some scientists have suggested that occupational exposure to benzene and pesticides may be involved, given their association with AML,[42] but the evidence for their relationship to CML is unclear.[49,50]

Findings

Leukemia was selected for study based on an excess of over 40% among females in Warren County relative to females in NYS. NYC is much more racially and ethnically diverse than the

rest of the state. Therefore, when a county's cancer incidence rate differs relative to NYS but not relative to NYS excluding NYC, we frequently suspect that the difference may be related to differences in cancer rates by race/ethnicity and the racial/ethnic composition of the county's population.

Leukemia incidence rates vary markedly by race/ethnicity (Table 13-1). The reasons for these racial/ethnic differences are not well understood. Rates are highest among non-Hispanic whites, intermediate among Non-Hispanic blacks and Hispanics, and lowest among Asians and Pacific Islanders. Of the 93 Warren County leukemia cases diagnosed between 2011 to 2015, 92 were non-Hispanic white. Thus, our subsequent analyses were limited to non-Hispanic whites.

Table 13-1 Leukemia Incidence Rates[1] by Race/Ethnicity, Warren County, New York State excluding New York City, and New York State, 2011-2015

Race/Ethnicity	Warren County		NYS excl. NYC		NYS	
	Male	Female	Male	Female	Male	Female
Overall	25.8	18.9 #	23.2	13.7	21.2	12.7
non-Hispanic white	25.8	19.5	24.3	14.3	24.0	14.2
non-Hispanic black	---	---	16.5	9.6	14.0	9.0
Hispanic	---	---	14.5	10.2	13.6	9.4
Asian/Pacific Islander	---	---	12.1	7.9	11.1	7.1

[1] Rates are per 100,000 persons, age-adjusted to the 2000 US standard population.

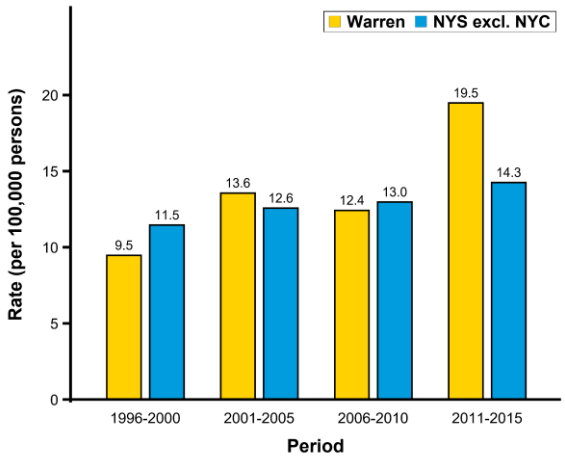
[#] The rate for Warren County is statistically different from the rate for NYS at p<0.05 level.

Although the leukemia incidence rate for non-Hispanic white females in Warren County was elevated by 36% relative to NYS excluding NYC and by 37% relative to NYS, neither difference was statistically significant. The leukemia incidence rate for non-Hispanic white males in Warren County did not differ appreciably from the rate for non-Hispanic white males in either comparison area. For all racial/ethnic groups leukemia rates were higher among males.

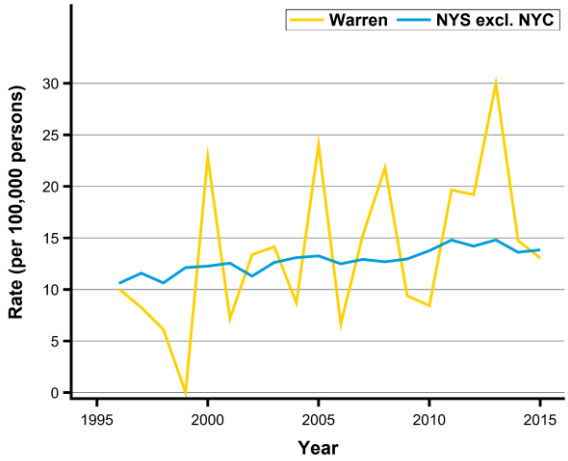
Figure 13-1(A) compares leukemia incidence rates for non-Hispanic white females in Warren County and NYS excluding NYC by five-year time periods going back to 1996. Leukemia incidence rates in both areas increased from 1996-2000 to 2011-2015. The rates for Warren County did not differ appreciably from the rates for NYS excluding NYC until the 2011-2015 period. The rates for Warren County were highly variable and alternated between showing excesses and deficits in successive periods relative to rates for NYS excluding NYC. Figure 13-1(B), which provides data by single year of diagnosis, illustrates the highly variable nature of the incidence rates in Warren County. Thus the 2011-2015 period, which groups data together for 2011 and 2013, each a peak year, may represent an anomaly. As mentioned above, the difference in rates between Warren County and NYS excluding NYC for 2011-2015 was not statistically significant.

Figure 13-1 Incidence Rates[1] of Leukemia among non-Hispanic White Females for Warren County and New York State excluding New York City, 1996-2015

(A) 5-year Average Rate



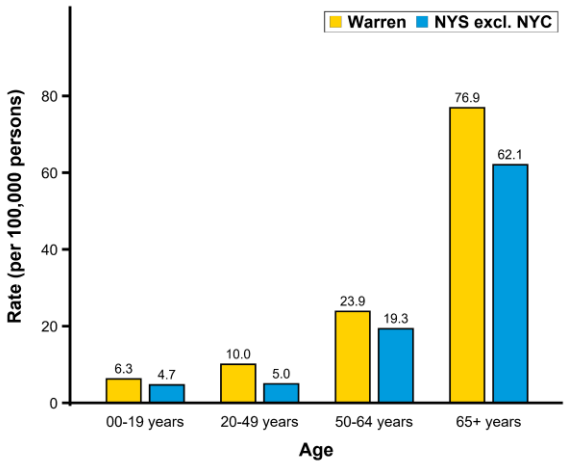
(B) Annual Rate



[1] *Incidence rate was age-adjusted to the 2000 US standard population*

The elevation in leukemia incidence among non-Hispanic white females in Warren County was present across all age groups during the 2011-2015 period (Fig. 13-2). The relative excess was greatest for females 20 to 49 years of age, for whom the rate was doubled. However, the rate was based on only six cases and was not statistically different from the comparable rate for NYS excluding NYC. It should also be noted that most of the excess in leukemia among females in Warren County can be attributed to an increase in leukemia among the elderly (ages 65 and over).

Figure 13-2 Incidence Rates[1] of Leukemia among non-Hispanic White Females by Age, Warren County and New York State excluding New York City, 2011-2015



[1] *Incidence rate was age-adjusted to the 2000 US standard population*

Since they have somewhat different sets of risk factors, the subtypes of leukemia were examined separately. Although there was no overall excess in leukemia among males in Warren County, we included males in the analyses by leukemia subtype to determine whether subtype patterns differed by gender. Table 13-2 provides the number of cases and age-adjusted incidence rates by sex for non-Hispanic whites in Warren County and NYS excluding NYC for the four major subtypes. There were also cases of various less frequently diagnosed types of leukemia.

- Relative to NYS excluding NYC, males in Warren County had higher rates of ALL and AML and lower rates of CML. None of the differences in rates were statistically significant.
- Rates for females in Warren County were elevated for all four leukemia subtypes compared to NYS excluding NYC, although the percent excess was only appreciable for CLL.

Table 13-2 Number of Leukemia Cases and Incidence Rates[1] among non-Hispanic Whites by Leukemia Subtype and Sex, Warren County and New York State excluding New York City, 2011-2015

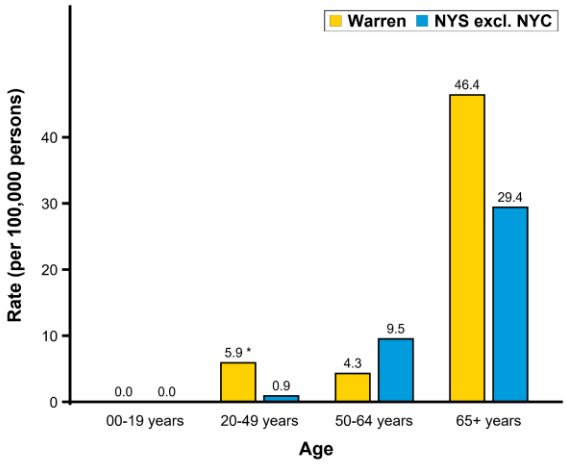
Leukemia Subtype	Warren County				NYS excl. NYC				Percent Excess[2]	
	Male		Female		Male		Female			
	Cases	Rate	Cases	Rate	Cases	Rate	Cases	Rate	Male	Female
ALL	4	3.1	2	1.8	403	2.1	304	1.6	49	17
CLL	20	10.3	21	9.1	2,802	10.3	1,903	5.5	0	64
AML	16	8.3	11	4.9	1,616	6.4	1,214	4.0	30	24
CML	5	2.6	5	2.0	739	2.9	531	1.8	-12	8

[1] Rates are per 100,000 persons, age-adjusted to the 2000 US standard population.
[2] Percent excess is based on rates that have not been rounded.

We also examined incidence rates for the four major leukemia subtypes by age and sex. Numerical results are not presented due to the small numbers of cases for most subtypes in Warren County when stratified by sex and age.

- No unusual patterns were detected except for CLL among females.
- Typically, the risk of CLL goes up with age, as illustrated by the CLL age-distribution for NYS excluding NYC (Fig. 13-3). In Warren County, the rate did not increase uniformly with age. The rate for non-Hispanic white females 20 to 49 years of age was higher than the rate for females 50 to 64 years of age.
- While the rate for non-Hispanic white females, 20 to 49 years of age, in Warren County was significantly elevated compared to NYS excluding NYC, the rate for females 50 to 64

Figure 13-3 Incidence[1] of CLL among non-Hispanic White Females by Age, Warren County and New York State excluding New York City, 2011-2015



[1]Incidence rate was age-adjusted to the 2000 US standard population.
** The rate for Warren County is statistically different from the rate for NYS excl. NYC at p<0.05 level.*

years of age exhibited a 55% deficit relative to NYS excluding NYC. It should be noted that only 5 of the female CLL cases in Warren County were below the age of 65.

- Despite the unusual age distribution, most of the excess in CLL among females in Warren County can be attributed to the increase in CLL among elderly females (ages 65 and over).
- Most of the overall leukemia excess among non-Hispanic white females 20-49 years of age, noted previously and in Figure 13-2, can be explained by the excess in CLL.

Leukemia diagnoses can occur more frequently in people who have had a prior cancer. For ALL, AML, and CML, this may be due to the associations of these types of leukemia with therapies used to treat other cancers, such as radiation and certain types of chemotherapy. For CLL, the explanation is less clear.

- None of the six people with ALL in Warren County had a history of a prior cancer.
- Seven of the people in Warren County with CLL or 17% had a history of a prior cancer compared to 19% of non-Hispanic white people with CLL in NYS excluding NYC. These figures are comparable.
- History of prior cancers was highest for people with AML. In Warren County 11 of the 27 people with AML or 41% had a prior cancer. For non-Hispanic whites with AML in NYS excluding NYC that figure was 39%, which is comparable.
- History of prior cancers was also comparable for people with CML at 14% for non-Hispanic whites in Warren County and 22% for non-Hispanic whites in NYS excluding NYC.

Given the comparable percentages of leukemia cases with a history of prior cancers in Warren County and NYS excluding NYC, it is unlikely that radiation treatment or chemotherapy for a prior cancer can account for a sizeable proportion of the excess in leukemia incidence in Warren County.

Chronic leukemias can be detected by routine blood testing. At least in their early stages, they can be treated in a doctor's office, or may not be treated at all. A person with a chronic leukemia may therefore never be hospitalized for their condition. Since the greatest share of cancer reports have historically come from hospitals, the degree to which other reporting sources, such as diagnostic and treatment centers, physician practices and laboratories, report cancer cases may affect the incidence total. The proportion of CLL cases in Warren County reported by either physician practices or laboratories did not differ from the proportion of non-Hispanic white CLL cases reported by these sources in NYS excluding NYC (21.9% versus 23.1%). Therefore, it is unlikely that the excess can be explained by reporting patterns.

Discussion

Although the leukemia incidence rate for non-Hispanic white females in Warren County was elevated during 2011-2015, the rate was not statistically different from the rate for non-Hispanic white females in NYS excluding NYC. Most of the observed excess can be attributed to an excess in CLL. However, the CLL incidence rates for non-Hispanic white females in Warren

County and in NYS excluding NYC were also not statistically different.

We observed an unusual CLL age distribution among non-Hispanic white females in Warren County. Namely, we observed a statistically significant excess in the CLL incidence rate for females 20-49 years of age. However, we also observed a deficit in the CLL incidence rate for females 50-64 years of age. This pattern suggests a shift toward earlier diagnosis for some CLL cases.

Survey data suggest that a greater proportion of Warren County residents under age 65 had health care coverage, which would improve access to medical care. This may in part explain the elevation in the CLL rate among females 20-49 years of age. However, most of the excess in CLL was among older females, ages 65 and over, the vast majority of whom have Medicare. However, apart from insurance coverage, there is some evidence that people in Warren County have more contact with the medical care system. This may account for the observed excess in CLL.

Given the lack of a statistically significant excess in leukemia among non-Hispanic white females in Warren County when the appropriate comparison population was employed, and the highly variable annual leukemia incidence rates, it is likely that the excess observed for 2011-2015 represents an anomaly. Examination of data for 2012-2016 supports this conclusion. The incidence of leukemia among non-Hispanic white females in Warren County dropped from 19.5 to 16.2 per 100,000 between 2011-2015 and 2012-2016. Compared to non-Hispanic white females in NYS excluding NYC, the excess dropped from 36% to 14%.

14. Limitations

General Considerations

When attempting to draw conclusions from the data presented, there are certain considerations that should be kept in mind. One important issue is migration, that is, movement of people into or out of the study area. Cancer cases were identified among persons who resided in the study area when their cancers were diagnosed. Former residents of the study area who moved away prior to being diagnosed with cancer could not be included, while persons who developed cancer shortly after moving into the area were included.

This issue is particularly important in view of the long latency period of many cancers. Cancer latency refers to the time between first exposure to a cancer-causing agent and the appearance of cancer symptoms. For many cancers in adults, latency can be 10 years or more. This long latency gives people ample time to relocate in the time between exposure and the diagnosis of cancer.

When evaluating the possible contribution of environmental factors, it is important to consider exposure. Exposure is contact with a substance. For any substance to have an effect on human health, people have to be exposed to it. People may be exposed to a chemical substance by breathing it in (inhalation), consuming it in food or water (ingestion), or getting it on their skin (dermal exposure). Even with exposure, not all hazardous substances cause cancer. The risk of developing cancer upon exposure to a cancer-causing substance depends on the amount of the substance people are exposed to, the length of time they are exposed to it, and how often they are exposed to it.

With the conventional standard for statistical significance used in this study, approximately one out of every 20 statistical tests (5%) will be statistically significant due to chance alone. In this study, a large number of comparisons were made between incidence rates in Warren County and reference areas (i.e., NYS excluding NYC and/or NYS) for different subgroups, such as age groups and tumor subtypes. When many statistical tests are done, the probability is high that some statistically significant differences will occur entirely by chance.

Limitations of Data Sources

It is important to understand the strengths and limitations of each source of data used in the investigation.

Cancer Registry

The cancer-related analyses in this study were based on data contained in the New York State Cancer Registry. As illustrated in the further evaluation of the diagnoses of chronic leukemias, variation in cancer incidence among different geographic areas reflects not only true differences in cancer incidence, but also differences in how cancer is diagnosed, treated, and

recorded in different areas of the state. The completeness and accuracy of the Cancer Registry data depend upon reporting from hospitals, laboratories, other healthcare facilities, physicians and other sources. The Cancer Registry has been certified as more than 95 percent complete by the North American Association of Central Cancer Registries. In addition, the Cancer Registry has received gold certification from the Association since 2000 (data year 1996), the highest certification given to central cancer registries.

Behavioral, Lifestyle, Medical Care Utilization

Information on health behavior and lifestyle characteristics (e.g. smoking prevalence, binge drinking, obesity, and leisure time physical activity) was obtained from the Expanded Behavioral Risk Factor Surveillance System (e-BRFSS), a telephone survey of the New York State population. The survey was designed to sample an approximately equal number of people in each county. Some indicator estimates had wider margins of error (confidence intervals) than others. Likely due to the small sample size, most differences observed between Warren County and NYS excluding NYC were not statistically significantly different. We referred to these differences as "suggestive". Regarding specific questions, the e-BRFSS assessed smoking based on the percentage of current cigarette users, while former smokers are also at increased risk for many types of cancer. Similarly, the e-BRFSS focused on binge drinking, which is not the same as heavy drinking. Even moderate alcohol consumption increases the risk for several types of cancer. In addition, the accuracy of the data depends on the accuracy of people's answers to the survey questions, which may vary based on the sensitivity of the questions and the social desirability of the answer. There is no reason to believe, however, that any biases would operate differently in the study area than in the comparison areas.

Hospital inpatient and outpatient discharge data from the Statewide Planning and Research Cooperative System (SPARCS) were used as an indirect measure of potential past occupational exposure to asbestos. Hospital discharge data were created for administrative purposes and have limitations when used for research.

Occupation

Data on occupations were obtained from the American Community Survey of the US Census. This is another sample survey with a wide margin of error in small areas, so small differences between areas may not be meaningful. Data on occupation is generally tabulated into broad categories, and a large concentration of people in a specific occupation within a broad category might not be apparent.

Environmental Data Sources

There are several limitations associated with examining environmental factors and their relationship to cancer development. First, the availability of environmental data is limited across space and time. For example, prior to the Clean Air and Water Acts of the 1970s, identification and control of sources of pollution released into the environment was not systematically enforced or recorded. Similarly, environmental monitoring networks do not

provide complete insight into all areas of NYS. Even now, data are not always readily available in digital or geographical formats.

Second, many of the environmental data sets that are available have not been developed specifically to evaluate human exposures to chemicals in the environment (e.g., regulatory compliance and monitoring data). The amount and length of an individual's exposure as well as the likelihood of an environmental hazard to cause cancer are critical considerations in assessing the significance of environmental risk factors. Therefore, although this review could potentially identify questions that warrant further investigation, it was not able to quantify individual exposures to environmental hazards.

Third, although environmental data have become more available over time, past exposures (as much as 40 years in the past) are generally more important for a full understanding of an individual's cancer risk. Available data do not include information about an individual's history of personal behaviors and specific exposures related to occupations and other activities.

Additionally, people are usually exposed to mixtures of chemicals rather than to a single chemical. Evaluating the health risks of mixtures is difficult for several reasons, including the lack of information on chemical mixtures' effects on human health. This evaluation did not consider any modifications to a chemical's potency for any additive, antagonistic, or synergistic effects.

Despite these challenges, DOH and DEC collaborated to summarize the readily available current and historical environmental data for each study region in order to make appropriate comparisons with other areas of NYS.

15. Conclusions

It is likely that a higher prevalence of current and former tobacco use contributed to the elevated incidence of lung, laryngeal, esophageal, and oral cancers in Warren County. Of all cancers, these four types are most strongly associated with tobacco use. For 2011-2015 the elevations in incidence for these cancers are more pronounced in and/or limited to men. Given that the prevalence of current smoking among women in Warren County is significantly higher than in NYS excluding NYC, it is likely that the difference in incidence between Warren County and NYS excluding NYC will become more pronounced among women in the future. Incidence rates for these cancers increase with age, that is, rates for individuals 65 years of age and older are higher than rates for younger individuals. Thus, it is concerning that the relative excess in incidence rates for these cancers tended to be higher among individuals 50-64 years of age -- and in some instances even among individuals 20-49 years of age -- than among individuals 65 years of age and older.

Alcohol consumption, independently and/or through a synergetic effect with tobacco use, might have contributed to the excess of oral, esophageal, and laryngeal cancers in Warren County, particularly among men. HPV infection could also have contributed to the oral cancer excess.

Most of the elevation in thyroid cancer incidence rates among women in Warren County is likely due to increased detection of small papillary tumors by medical imaging and other diagnostic techniques. The higher prevalence of overweight or obese among women could also have contributed to the excess in female thyroid cancer incidence as well as the excess in female colorectal incidence.

The non-significant excess in leukemia incidence among females in Warren County was mainly due to a non-significant excess in chronic lymphocytic leukemia (CLL). The excess in reported CLL may be related to a detection bias due to greater healthcare utilization among females in Warren County. Alternatively, the excess in female leukemia may represent a time-limited anomaly.

This investigation uncovered no factors that might account for the elevated incidence of cancers of the brain and ONS among females in Warren County. Nor are we able to explain the increase in the incidence of pilocytic astrocytoma tumors found among individuals less than 20 years of age in Warren County. Given the large number of statistical comparisons made, it is possible that this finding occurred by chance. Even after intensive investigation, the causes of many reported clusters of childhood cancers remain unknown. These occurrences are often limited in time. We will continue to monitor the incidence of brain and ONS cancers in Warren County.

In general, the review and evaluation of environmental factors in this study, including levels of radon in indoor air, environmental contaminants in outdoor air, industrial and inactive

hazardous waste disposal sites, and traffic density, did not identify any factors that stood out from those in other parts of NYS excluding NYC. Some violations occurred intermittently for specific public water systems, however it is highly unlikely that exposure to contaminants in drinking water contributed to the excess cancer burden in Warren County. Finally, indirect evidence based on asbestosis hospitalization rates suggests that past exposure to asbestos was not elevated in Warren County.

16. Recommendations

The recommendations below are divided into two main sections: 1) recommended actions to address the specific cancers that were elevated in the Warren County Study Area, and 2) recommended actions to address all cancer types throughout New York State. Recommended actions to address the specific cancers that were elevated in the Warren County Study Area are organized around four categories: health promotion and cancer prevention; cancer screening and early detection; healthy and safe environment; and ongoing cancer and environmental health surveillance. Many of these specific recommended activities are aligned with two existing State plans that address cancer prevention and control, the *New York State 2018-2023 Comprehensive Cancer Control Plan*, and the *New York State Prevention Agenda 2019-2024*. Details about these two plans are also described at the end.

Recommended Actions Based on Specific Cancers Elevated in the Warren County Study Area

Health Promotion and Cancer Prevention

Tobacco Prevention: More work is needed to build on the progress NYS achieved as a result of tobacco- and smoke-free environments, high cigarette excise taxes, and health communication campaigns. While NYS lung cancer incidence and smoking rates are at record lows, further declines will only be achieved with a continued focus on eliminating tobacco as a major cancer risk factor.

> **Recommendation:** Prevent initiation of tobacco use, including combustible tobacco and electronic vaping products by youth and young adults.
>
> **Recommendation:** Promote tobacco use cessation, especially among populations disproportionately affected by tobacco use including: low socioeconomic status; frequent mental distress/substance use disorder; lesbian, gay, bisexual and transgender; and disability.
>
> **Recommendation:** Eliminate exposure to secondhand smoke and exposure to secondhand aerosol/emissions from electronic vapor products.

Alcohol Use: Many people may not know that drinking alcohol, including red and white wine, beer, cocktails, and liquor, increases the risk of some cancers. More work is needed to educate New Yorkers about alcohol and the risk of cancer, and to prevent underage drinking and excessive alcohol consumption by adults.

> **Recommendation:** Implement environmental approaches, including reducing alcohol access, implementing responsible beverage services, reducing risk of drinking and driving, and restricting underage alcohol access.

Recommendation: Collaborate with partners and key stakeholders to educate the public, including youth and young adults, on cancer risk related to alcohol usage.

Recommendation: Provide personalized feedback about the risks and consequences of excessive drinking through the use of electronic screening and behavioral counseling interventions in healthcare settings, schools, and emergency rooms.

Recommendation: Among persons meeting the diagnostic criteria for alcohol dependence, promote the use of alcohol misuse screening and brief behavioral counseling interventions via traditional (face to face) or electronic means, and referrals to specialty treatment.

Healthy Nutrition and Physical Activity: It is estimated that up to one-third of all cancers may be attributed to excess weight, physical inactivity, and unhealthy diet. Adopting an active lifestyle, eating a healthy diet and maintaining a healthy weight can help lower the risk of cancer and improve cancer mortality rates.

Recommendation: Promote healthy eating and food security by:

- Increasing access to healthy and affordable foods and beverages,
- Increasing skills and knowledge to support healthy food and beverage choices,
- Increasing food security, and
- Increasing awareness of DOH sportfish advisories to promote healthier fish consumption choices while reducing chemical exposures (https://www.health.ny.gov/environmental/outdoors/fish/health_advisories/).

Recommendation: Increase physical activity by:

- Improving community environments that support active transportation and recreational physical activity for people of all ages and abilities,
- Promoting school, child care, and worksite environments that support physical activity for people of all ages and abilities, and
- Increasing access, for people of all ages and abilities, to safe indoor and/or outdoor places for physical activity.

HPV Vaccination: HPV (human papilloma virus) is one of the most common sexually transmitted infections. HPV infection can lead to cancer in both males and females, including cervical, vaginal, penile, anal and oral cancers. Children ages 11 to 12 should be vaccinated for HPV. Catch-up vaccination is recommended for all persons though age 26 who are not adequately vaccinated. Some adults aged 27 through 45 years may also benefit from receiving the HPV vaccine. Adults in this age group can discuss the HPV vaccine with their health care provider to determine if the HPV vaccine is right for them.

Recommendation: Develop and implement educational campaigns targeted to adolescents and adults regarding the benefits and risks of HPV vaccine.

Recommendation: Maximize use of the New York State Immunization Information System (NYSIIS) and the Citywide Immunization Registry (CIR) for vaccine documentation, assessment, decision support, reminders and recall.

Recommendation: Adopt local HPV policies which support HPV vaccination in adolescents and expand vaccine availability to new venues such as more healthcare settings and schools.

Exposure to Ultraviolet (UV) Radiation: Unprotected or extended exposure to ultraviolet (UV) radiation from the sun, indoor tanning or tanning lamps can lead to skin cancer, the most common cancer among men and women in NYS. UV radiation causes up to 90% of all melanomas, the deadliest form of skin cancer.

Recommendation: Promote educational initiatives that stress sun safety messages and provide clear information about the cancer risk associated with indoor tanning to decrease exposure to UV radiation for people of all ages, especially initiatives that target children, adolescents, young adults, parents, healthcare providers, and summer camp instructors.

Recommendation: Implement environmental changes for sun protection in outdoor settings such as access to shade and sunscreen in playgrounds, schools, summer camps, and other outdoor recreational settings, and increase the availability of sun protection in occupational settings for outdoor workers.

Recommendation: Promote awareness of, and compliance with, NYS's tanning law restricting minors from the use of indoor tanning facilities.

Cancer Screening and Early Detection

The Centers for Disease Control and Prevention (CDC) and DOH support the screening recommendations of the U.S. Preventive Services Taskforce (USPSTF). The USPSTF is an independent panel of national experts that makes recommendations about the effectiveness of cancer screening and other preventive care services for patients without signs or symptoms. The panel examines the benefits and harms of the screening or service and does not consider costs as part of the assessment. The USPSTF recommends routine screening for breast, cervical, colorectal, and lung cancers.

Lung Cancer Screening: Since 2013, the U.S. Preventive Services Task Force has recommended lung cancer screening by low-dose CT scan for high-risk individuals between ages 55 and 80 years who have a history of heavy smoking and either currently smoke or have quit within the past 15 years. However, studies have shown very few heavy smokers who meet these criteria receive lung cancer screening.

Recommendation: Educate men and women who meet the criteria for lung cancer screening about the benefits and risks of screening to help them make informed decisions.

Recommendation: Healthcare providers need tools and support to engage with patients who may benefit from screening, and facilities adopting lung cancer screening programs should be following national guidelines for a quality program.

Colorectal Cancer Screening: The U.S. Preventive Services Task Force recommends that adults age 50 to 75 be screened for colorectal cancer. The decision to be screened after age 75 should be made on an individual basis; individuals older than 75 should talk with their health care providers. People at an increased risk of developing colorectal cancer should talk to their health care providers about when to begin screening, which test is right for them, and how often to get tested. There are several types of screening tests that can be used to find polyps or colorectal cancer.

Recommendation: Educate men and women who meet the criteria for colorectal cancer screening about the benefits and risks of screening to help them make informed decisions.

Recommendation: Educate providers and the public that there are many testing options for colorectal cancer screening including take-home tests.

Recommendation: Reduce cost-related barriers to screening by educating providers and the public that health insurance plans in New York State are required to cover screening, and for those who are uninsured, the New York State Cancer Services Program (CSP) provides free colorectal cancer screening to men and women age 50 and older.

Recommendation: Support primary care practices and staff to implement evidence-based strategies outlined in the Guide to Community Preventive Services such as the use of patient and provider screening reminders.

Thyroid Cancer Screening: The U.S. Preventive Services Task Force recommends *against* screening for thyroid cancer in asymptomatic adults. The USPSTF gives thyroid screening a "D" grade, meaning "there is moderate or high certainty that the service has no net benefit or that the harms outweigh the benefits." The USPSTF suggests that health care providers discourage the use of services with a D grade. (Note: This recommendation does not apply to people who have a family history of medullary thyroid cancer; these individuals may need genetic testing, blood testing and/or thyroid ultrasounds.)

Recommendation: Educate the public and healthcare providers about recommendations *against* thyroid cancer screening in average risk, asymptomatic adults.

Healthy and Safe Environment

Radon Testing and Mitigation: Radon is a naturally occurring, radioactive gas found in soil and rock. It seeps into homes through cracks in the foundation, walls, and joints. Radon comes from the breakdown of uranium in soil, rock and water and gets into the air people breathe. Radon is the second leading cause of lung cancer. Many individuals may not be aware that radon is the

second leading cause of lung cancer.

Recommendation: Improve the public's awareness about the relationship between indoor radon exposure and lung cancer by conducting outreach and education about building testing and remediation. Promote the DOH's free and low-cost radon test kit programs, provision of test kits at half price to schools and daycares, and free test kits as part of the DOH's Healthy Neighborhoods Program and other grant-funded programs.

Recommendation: Explore local level policy and/or code adoption to require radon resistant construction in high radon areas.

Recommendation: Promote healthcare provider screening for radon testing particularly in high-risk radon areas. Increase the number of physicians that ask their patients if they have had their homes tested for radon and refer them to the DOH, as needed. Add radon testing questions to routine electronic medical questionnaires.

Radiation from Medical Imaging: Medical imaging tests, such as X-rays, computed tomography (CT) scans, and fluoroscopy, are non-invasive tests that health care providers use to diagnose diseases and injuries. Some of these tests use ionizing radiation which can lead to a small increase in the risk of cancer later in life.

Recommendation: Increase awareness of such programs as NYS's "Image Gently" and the national "Image Wisely" campaigns that educate physicians and the public about potential radiation exposure from CT scans and X-rays in both children and adults.

Safety in the Workplace: Exposure to substances in the workplace may increase cancer risk. This includes prolonged or intense exposure (in higher concentrations than typically found outside the workplace) to UV radiation, toxic wastes, agricultural pesticides, some industrial and manufacturing products, some outdoor landscaping materials, and hazardous substances such as asbestos, arsenic, benzene, chromium, vinyl chloride, and silica.

Recommendation: Develop targeted occupational safety and health training programs for employers and workers in high-risk jobs.

Recommendation: Incorporate industry and occupation into electronic health records and other patient-oriented databases.

Recommended Actions to Reduce the Burden of All Cancers Statewide

Preventing and controlling cancer requires individuals and organizations of all kinds to get involved and make contributions. Below are highlights of what individuals can do and what DOH and its partner organizations are doing. For more information on activities, by type of organization, that New Yorkers can do to help reduce the burden of cancer, see:

https://www.health.ny.gov/diseases/cancer/consortium/docs/2018-2023_comp_cancer_control_plan.pdf#page=62.

For All New Yorkers

Different cancers have different causes and there are many factors that affect a person's chances of getting different types of cancer. It is not always possible to know why one person develops cancer while another person does not. But the following are things that all individuals can do to reduce their risk of cancer:

- If you use tobacco, quit. If you don't use tobacco, don't start.
- Eat nutritious meals that include fruits, vegetables and whole grains.
- Get moving for at least 30 minutes a day on five or more days each week.
- Use sunscreen, monitor sun exposure and avoid tanning salons.
- Limit alcohol use.
- Get cancer-preventive vaccines such as hepatitis B and HPV.
- Learn your family health history (if possible) and discuss with your healthcare provider whether genetic counseling might be right for you.
- Discuss what cancer screening tests might be right for you with your healthcare provider.
- Test your home for radon.
- For women of child-bearing age, know the benefits of breastfeeding and, if possible, breast-feed infants exclusively for at least the first six months of life.

For NYS Department of Health and Partner Organizations

Cancer Surveillance: The New York State Cancer Registry (NYSCR) was designated by the CDC (Centers for Disease Control and Prevention) as a Registry of Excellence and has achieved Gold-level certification since 1998. In 2018, the NYSCR became a member of the National Cancer Institute's Surveillance, Epidemiology and End Results Program (SEER), the nation's preeminent source of population-based cancer data.

> **Recommendation:** Continue to meet the highest cancer registry standards for timeliness, completeness and quality of data, and make these data available to researchers, clinicians, public health officials, legislators, policymakers, community groups and the public.

Environmental Health: DOH's Center for Environmental Health (CEH) works collaboratively with other agencies including the NYS Department of Environmental Conservation (DEC), the federal Environmental Protection Agency (EPA), the Centers for Disease Control and Prevention (CDC), and the Agency for Toxic Substance and Disease Registry (ATSDR). CEH staff investigate the potential for human exposures from chemicals, radiation, microbes, or anything in the physical world at home, school, work or play that might affect health. CEH programs evaluate health effects associated with environmental exposures, develop policies, and maintain a variety of programs to reduce and eliminate exposures.

> **Recommendation:** Continue to identify and assess potential exposures throughout the

state and take action to reduce those exposures. NYS will continue to support programs to promote and maintain clean air, clean water and reduce human exposures to environmental hazards, with particular attention to the needs of environmental justice communities.

Recommendation: Promote awareness of programs and initiatives to reduce environmental hazards in our communities. Several state agencies promote programs and publish educational materials to reduce environmental exposures and improve health in our communities:

- DEC, Office of Environmental Justice: http://www.dec.ny.gov/public/333.html
- DOH, Health and Safety in the Home, Workplace and Outdoors: https://www.health.ny.gov/environmental/
- DOH, Healthy Neighborhoods Program: https://www.health.ny.gov/environmental/indoors/healthy_neighborhoods/
- DOH, Reducing Environmental Exposures - The Seven Best Kid-Friendly Practices: https://www.health.ny.gov/publications/2818/
- DEC, Green Living: http://www.dec.ny.gov/public/337.html
- NYSERDA's change-out incentive program for high-efficiency, low-emission wood heating systems: https://www.nyserda.ny.gov/All-Programs/Programs/Renewable-Heat-NY
- DOH, Protect and test your private drinking water wells: https://www.health.ny.gov/publications/6628.pdf

Statewide Initiatives: The overarching goal of cancer prevention and control efforts in New York State (NYS) is to reduce the burden of cancer by decreasing the number of new cancer cases, decreasing the number of cancers diagnosed at late stages, improving the quality of life of those diagnosed with cancer, and decreasing the number of deaths caused by cancer. These efforts are detailed in two State plans, the *New York State 2018-2023 Comprehensive Cancer Control Plan*, and the *New York State Prevention Agenda 2019-2024*.

- **New York State 2018-2023 Comprehensive Cancer Control Plan (NYS CCCP)**

The *NYS 2018-2023 Comprehensive Cancer Control Plan* (Plan) was developed by the NYS Cancer Consortium and serves as a guide for community members, policy makers, advocates, healthcare professionals and others to use as they engage in efforts in their local communities and across the state. The NYS Cancer Consortium is a network of the Department of Health and over 200 individuals and organizations in NYS that collaborate to address the burden of cancer in NYS.

The 2018-2023 Plan is organized around seven priority areas: 1) Cancer-Related Health Equity; 2) Health Promotion and Cancer Prevention; 3) Early Detection; 4) Treatment; 5) Survivorship; 6) Palliative Care; and 7) Health Care Workforce. Each priority area contains background

information about the status of work in the area; objectives with which to measure improvements; suggested evidence-based or promising practices to make improvements; and other related resources. More details about the NYS Cancer Consortium and the Plan can be found at: https://www.health.ny.gov/diseases/cancer/consortium/index.htm.

- **New York State Prevention Agenda 2019-2024 (NYS PA)**

The *NYS Prevention Agenda 2019-2024* (Prevention Agenda) is New York's six-year state health improvement plan; it is the blueprint for state and local action to improve the health of New Yorkers and to reduce health disparities. The Prevention Agenda was developed by the Department of Health and an Ad Hoc Committee made up of a diverse set of stakeholders including local health departments, health care providers, health plans, community-based organizations, academia, employers, state agencies, schools and businesses.

The Prevention Agenda has five priorities: 1) Prevent Chronic Diseases; 2) Promote a Healthy and Safe Environment; 3) Promote Healthy Women, Infants and Children; 4) Promote Well-Being and Prevent Mental and Substance Use Disorders; and 5) Prevent Communicable Diseases. Each priority area has an action plan that identifies goals and indicators to measure progress and recommended policies and evidence-based interventions.

Cancer-related goals are found throughout the Prevention Agenda, including promoting healthy eating, physical activity, tobacco prevention, and cancer screening; ensuring outdoor air quality and quality drinking water; and mitigating public health risks from hazardous exposures from contaminated sites. More details about the NYS Prevention Agenda can be found at: https://www.health.ny.gov/prevention/prevention_agenda/2019-2024/.

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Appendix I – Description of Data Sources

The **New York State Cancer Registry** is a population-based cancer incidence registry responsible for the collection of demographic, diagnostic and treatment information on all patients diagnosed with and/or treated for cancer at hospitals, laboratories and other health care facilities throughout New York State. Submission of data is mandated under New York State Public Health Law, section 2401. The Cancer Registry collects a wide variety of information that can be used for research and public health planning and evaluation. Cancer Registry data are routinely used by programs within the Department of Health, county and local health departments, patient advocacy groups, public interest groups, researchers and the public. Because the Registry has collected statewide data since 1976, it can be used to monitor cancer incidence patterns and trends for all areas of New York State.
(http://www.health.ny.gov/statistics/cancer/registry/about.htm)

The **County Population Estimates** used to calculate cancer incidence rates were published by the National Cancer Institute (NCI) for the purposes of national cancer surveillance. They represent a modification of the intercensal and Vintage 2016 annual time series of July 1 county population estimates by age, sex, race and Hispanic origin produced by the U.S. Census Bureau's Population Estimates Program, in collaboration with the National Center for Health Statistics, and with support from the NCI through an interagency agreement.
(https://seer.cancer.gov/popdata/methods.html)

The **New York State Behavioral Risk Factor Surveillance System (BRFSS)** is an annual statewide telephone surveillance system designed by the Centers for Disease Control and Prevention (CDC). New York State has participated annually since 1985. The BRFSS monitors modifiable risk behaviors and other factors contributing to the leading causes of morbidity and mortality in the population. New York State's BRFSS sample represents the non-institutionalized adult household population, aged 18 years and older. Data from the BRFSS are useful for planning, initiating, and supporting health promotion and disease prevention programs at the state and federal level, and monitoring progress toward achieving health objectives for the state and nation.
(http://www.health.ny.gov/statistics/brfss/)

The **Expanded Behavioral Risk Factor Surveillance System (e-BRFSS)**, is a county-level survey that augments the CDC Behavioral Risk Factor Surveillance System (BRFSS). The e-BRFSS is a random-digit-dialed telephone survey of adults 18 years of age and older representative of the non-institutionalized civilian population with landline and cellular telephones living in New York State. The goal of the e-BRFSS is to collect county-specific data on preventive health practices, risk behaviors, injuries and preventable chronic and infectious diseases. Topics assessed by the survey include tobacco use, physical inactivity, diet, use of cancer screening services, and other factors linked to the leading causes of morbidity and mortality. The 2013-14 e-BRFSS was designed with a sampling plan to generate statistically valid county-level estimates for all 57 counties outside New York City, and New York City (n=31,690). The sampling plan resulted in a

sufficient sample size to enable calculation of health indicators for several cities in Upstate New York. In 2016, the e-BRFSS was sampled to produce valid estimates for all 62 counties (n =34,058). Weights were developed for both the 2013-14 and 2016 e-BRFSS to enable the calculation of estimated population rates using a two-stage method developed by CDC.[1] During the first stage, weights reflecting the probability of selection were developed. The sample design yields a complex probability sample because different sampling fractions were used for each county landline frame and region cell phone frame. During the second stage, the weights were raked to US Census county- and region-level administrative control totals for sex, age, race, ethnicity, educational attainment, marital status, owner/renter status, and telephone usage group to help minimize bias due to differential nonresponse patterns (refusal and noncontact) among demographic categories associated with important health risks. For the 2013-14 e-BRFSS, weighting was completed by Clearwater Research.[2] For the 2016 e-BRFSS, CDC calculated the weights.
(https://www.health.ny.gov/statistics/brfss/expanded)

The **New York State Statewide Planning and Research Cooperative System (SPARCS)** is a comprehensive all payer data reporting system established in 1979 as a result of cooperation between the healthcare industry and government. The enabling legislation for SPARCS is located under Section 28.16 of the Public Health Law (PHL). The regulations pertaining to SPARCS are under Section 400.18 of Title 10 (Health) of the Official Compilation of Codes, Rules, and Regulations of the State of New York (NYCRR). The system was initially created to collect information on discharges from hospitals. SPARCS currently collects patient level detail on patient characteristics, diagnoses and treatments, services, and charges for each hospital inpatient stay and outpatient (ambulatory surgery, emergency department, and outpatient services) visit; and each ambulatory surgery and outpatient services visit to a hospital extension clinic and diagnostic and treatment center licensed to provide ambulatory surgery services.
(https://www.health.ny.gov/statistics/sparcs/)

The **American Community Survey,** conducted by the US Census Bureau, is an ongoing nationwide survey that gathers information on social, economic, housing and demographic characteristics of a population which can be used at many geographic levels such as states, counties, and cities. The data are used by a variety of communities including state and local governments, nongovernmental organizations, and researchers. The data are collected using four methods: paper questionnaires through the mail, phone interviews, personal visits with a Census Bureau coordinator, and an internet response option. Annually, a sample size of about 3.5 million addresses are randomly selected for participation. Data from the surveys are released in the year immediately following the year in which they are collected. In order to make the data more stable, the Census Bureau combines five consecutive years of ACS data to produce estimates at lower geographic levels, such as census tracts and small towns.
(https://www.census.gov/programs-surveys/acs/)

The **County Health Rankings and Roadmaps** program has been developed and maintained by the University of Wisconsin Population Health Institute with support from the Robert Wood Johnson Foundation. The Rankings are compiled using county-level measures from a variety of

national and state data sources. These measures are standardized and combined using scientifically-informed weights. It provides a snapshot of the health of all counties in US. The information is also used to identify health challenges and gaps, and to facilitate the design and implementation of policies and programs to improve population health. (http://www.countyhealthrankings.org/)

The **US Environmental Protection Agency's (EPA's) Air Quality System** database contains results of air pollutant measurements by air quality monitoring stations across the state in operation at various locations and times. The database contains measurements for criteria pollutants as far back as early 1965 and toxic air pollutants starting in the late 1980s. DOH began measuring pollutants in NYS in the mid-1960s and the NYS Department of Environmental Conservation (DEC) assumed responsibility for the air quality monitoring network after the agency was established in the early 1970s. DEC has been operating the statewide **Air Toxics Monitoring Network** since 1990. Currently, there are 11 sites statewide collecting 24-hour canister samples for a full suite of volatile organic chemicals in a 1 in 6-day interval. This network has measured air pollutants that are known or likely known to be human carcinogens. (https://www.epa.gov/aqs; https://www.epa.gov/outdoor-air-quality-data; and http://www.dec.ny.gov/chemical/8406.html)

The EPA's **National-scale Air Toxics Assessment (NATA)** provides modeled concentrations and estimated risks for outdoor air pollutants for the years 1996, 1999, 2002, 2005, 2011 and 2014. Over the years the number of EPA-designated hazardous air pollutants included in the model has varied from 32 for the 1996 NATA to 180 plus diesel particulate matter for the 2014 NATA. NATA's results help state, local and tribal air agencies identify which pollutants, emission sources and places they may wish to study further to better understand any possible risks to public health from air toxics. Air quality specialists use NATA results to learn which air toxics and emission source types may raise health risks in certain places. However, NATA assessments should not be used to examine trends from one NATA year to another. (https://www.epa.gov/national-air-toxics-assessment)

The **Hudson River Communities Project** is an environmental health study conducted by the DOH in the Fort Edward, Hudson Falls, and Glens Falls areas of Upstate New York from 2000 to 2002. The project aims to examine how polychlorinated biphenyls (PCBs) affect people's nervous system. In this study, outdoor and indoor air samples were collected from the study group (Fort Edward and Hudson Falls) and the comparison group (Glens Falls). PCB levels in air samples were also measured. (https://www.health.ny.gov/environmental/pcb/)

The **Radon Program** at the DOH Bureau of Environmental Radiation Protection provides short-term testing kits and results to New York State residents to inform them about radon levels in their homes. The results are entered in the program database and are currently available as maps and tables by county starting in 1987. It is important to note that the database is not a

comprehensive record of all tests conducted in NYS and only includes tests requested through the DOH Radon program and outreach efforts by the DOH. (https://www.health.data.ny.gov/Health/Radon-Test-Results-By-County-Beginning-1987/8e6u-9695).

The **Safe Drinking Water Information System (SDWIS)** is a data system developed by EPA to store information about public water systems and their violations of the EPA's drinking water regulations, with the main purpose of keeping public water systems in compliance. States supervise the public water systems within their jurisdictions to ensure that each system meets state and EPA standards for safe drinking water. NYS currently uses SDWIS as the primary repository for all public water system data. (https://www3.epa.gov/enviro/facts/sdwis/search.html)

The **Third Unregulated Contaminant Monitoring Rule (UCMR 3)** was published by the EPA on May 2, 2012. As required by the UCMR 3, the EPA collected data for 30 contaminants suspected to be present in water systems serving 10,000 individuals or more and a few selected systems with populations under this limit between 2013 and 2015. These **UCMR 3 (2013-2015) Occurrence Data** show the number of people potentially being exposed and an estimate of exposures to these 30 specific contaminants. This information provides the basis for future regulatory actions to protect public health. (https://www.epa.gov/dwucmr/occurrence-data-unregulated-contaminant-monitoring-rule#3)

DEC's **Environmental Site Remediation Database** contains records of the sites which are under remediation or are being managed under by the agency. All sites listed under the State Superfund, Brownfield Cleanup, Environmental Restoration and Voluntary Cleanup programs, as well as the Registry of Inactive Hazardous Waste Disposal Sites are included in this database. (https://www.dec.ny.gov/chemical/8437.html)

The New York State Department of Transportation (DOT) operates a **Traffic Monitoring Program** which collects information on traffic counts at fixed and temporary monitoring locations. This information is processed to create average annual daily traffic (AADT) counts for road segments along interstate highways and all NYS routes and roads that are part of the Federal Aid System. Computer software is used to link datasets with AADT with road segment locations. (https://www.dot.ny.gov/divisions/engineering/technical-services/highway-data-services)

References for Appendix I

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Appendix II – Supplemental Tables & Figures

Table A-II-1 Incidence Rates[1] and 95% Confidence Intervals by Cancer Site for Both Sexes, Warren County, New York State Excluding New York City, and New York State, 2011-2015[2]

Site	Warren County			NYS excl. NYC				NYS			
	Rate	LCI	UCI	Rate	LCI	UCI	% Diff	Rate	LCI	UCI	% Diff
All Invasive Malignant Tumors	560.6	538.2	583.8	511.3	509.6	513.1	9.6 *	488.9	487.5	490.2	14.7 *
Oral cavity and pharynx	15.3	11.8	19.5	11.4	11.1	11.6	33.9 *	10.8	10.6	10.9	41.8 *
Esophagus	6.7	4.6	9.6	5.1	5.0	5.3	31.1	4.5	4.4	4.7	48.0 *
Stomach	7.1	4.9	10.1	7.3	7.1	7.5	-3.2	8.8	8.6	8.9	-19.0
Colorectal	43.8	37.5	51.0	39.6	39.1	40.1	10.6	39.8	39.4	40.2	10.1
Liver / intrahepatic bile duct	5.4	3.6	8.0	7.1	6.9	7.3	-24.3	8.8	8.6	9.0	-38.9 *
Pancreas	13.8	10.7	17.8	14.2	13.9	14.5	-2.4	14.0	13.8	14.2	-1.1
Larynx	6.5	4.4	9.5	3.5	3.3	3.6	87.7 *	3.3	3.2	3.5	94.5 *
Lung and bronchus	79.6	71.7	88.3	67.2	66.6	67.9	18.4 *	60.2	59.8	60.7	32.2 *
Melanoma of the skin	25.7	21.1	31.2	23.2	22.9	23.6	10.7	18.2	17.9	18.4	41.6 *
Urinary bladder (incl. in situ)	28.4	23.8	33.8	27.3	26.9	27.7	4.0	23.4	23.1	23.7	21.3 *
Kidney and renal pelvis	20.6	16.4	25.6	18.0	17.6	18.3	14.7	16.5	16.2	16.7	24.9
Brain and other nervous system	12.0	8.5	16.4	7.2	7.0	7.4	66.8 *	6.6	6.4	6.8	81.1 *
Thyroid	25.5	20.3	31.7	19.6	19.2	19.9	30.4 *	19.9	19.6	20.2	28.0 *
Hodgkin lymphoma	2.1	0.8	4.5	3.3	3.2	3.5	-36.6	3.3	3.1	3.4	-35.2
Non-Hodgkin lymphomas	24.5	20.2	29.7	22.4	22.1	22.8	9.5	21.6	21.3	21.9	13.7
Myeloma	9.1	6.6	12.4	7.5	7.3	7.7	21.3	8.0	7.9	8.2	13.1
Leukemia	21.9	17.5	27.2	17.9	17.6	18.2	22.3	16.4	16.1	16.6	33.8 *

[1] Incidence rates (per 100,000 persons) are age-adjusted to the 2000 US standard population

[2] Data Source: NYS Cancer Registry

** Significant at $p<0.05$ level when comparing Warren County to NYS excl. NYC or NYS*

Table A-II-2 Incidence Rates[1] and 95% Confidence Intervals by Cancer Site among Males, Warren County, New York State Excluding New York City, and New York State, 2011-2015[2]

Site	Warren County			NYS excl. NYC				NYS			
	Rate	LCI	UCI	Rate	LCI	UCI	% Diff	Rate	LCI	UCI	% Diff
All Invasive Malignant Tumors	610.9	577.1	646.2	561.1	558.4	563.8	8.9 *	542.0	539.9	544.1	12.7 *
Oral cavity and pharynx	21.8	15.9	29.4	17.0	16.6	17.5	28.0	16.1	15.7	16.5	35.3
Esophagus	12.6	8.3	18.5	8.7	8.4	9.1	44.2	7.7	7.5	8.0	62.4 *
Stomach	11.1	7.1	17.0	10.3	9.9	10.7	8.2	12.1	11.7	12.4	-7.5
Colorectal	42.9	33.9	53.7	45.0	44.2	45.7	-4.6	46.0	45.4	46.6	-6.7
Liver / intrahepatic bile duct	8.5	5.2	13.5	11.0	10.7	11.4	-22.8	13.7	13.4	14.0	-37.9 *
Pancreas	18.3	13.0	25.3	16.1	15.7	16.6	13.4	15.9	15.6	16.3	14.8
Larynx	10.9	6.8	16.7	6.0	5.7	6.3	80.5 *	6.0	5.8	6.2	81.7 *
Lung and bronchus	92.8	80.2	107.0	74.5	73.6	75.5	24.4 *	69.1	68.3	69.8	34.3 *
Melanoma of the skin	33.8	26.3	43.1	29.2	28.6	29.8	16.0	23.3	22.9	23.7	45.2 *
Prostate	126.2	111.9	142.1	129.8	128.6	131.1	-2.8	131.7	130.7	132.7	-4.2
Testis	7.9	3.9	14.1	6.9	6.5	7.2	15.8	5.9	5.7	6.1	35.1
Urinary bladder (incl. in situ)	49.5	40.5	60.1	46.9	46.1	47.7	5.5	41.1	40.5	41.7	20.5
Kidney and renal pelvis	26.2	19.4	34.7	25.0	24.4	25.6	4.8	23.2	22.8	23.7	12.7
Brain and other nervous system	10.8	6.3	17.3	8.3	8.0	8.7	29.1	7.7	7.5	8.0	39.1
Thyroid	11.0	6.6	17.3	10.3	10.0	10.7	6.4	10.3	10.0	10.6	7.1
Hodgkin lymphoma	1.8	0.3	5.6	3.7	3.5	4.0	-51.1	3.7	3.5	3.8	-50.1
Non-Hodgkin lymphomas	26.9	20.2	35.2	27.4	26.8	28.0	-1.8	26.5	26.0	27.0	1.5
Myeloma	12.4	8.0	18.6	9.3	8.9	9.6	33.2	9.9	9.6	10.2	24.8
Leukemia	25.8	18.8	34.6	23.2	22.7	23.8	11.0	21.2	20.8	21.7	21.5

[1] Incidence rates (per 100,000 persons) are age-adjusted to the 2000 US standard population

[2] Data Source: NYS Cancer Registry

** Significant at $p<0.05$ level when comparing Warren County to NYS excl. NYC or NYS*

Table A-II-3 Incidence Rates[1] and 95% Confidence Intervals by Cancer Site among Females, Warren County, New York State Excluding New York City, and New York State, 2011-2015[2]

Site	Warren County			NYS excl. NYC				NYS			
	Rate	LCI	UCI	Rate	LCI	UCI	% Diff	Rate	LCI	UCI	% Diff
All Invasive Malignant Tumors	525.7	495.2	557.6	478.8	476.4	481.1	9.8 *	454.8	453.0	456.5	15.6 *
Oral cavity and pharynx	9.0	5.7	14.0	6.5	6.2	6.7	39.8	6.3	6.1	6.5	44.2
Esophagus	1.8	0.6	4.9	2.1	2.0	2.3	-14.8	2.0	1.9	2.1	-9.0
Stomach	3.9	1.9	7.5	5.0	4.7	5.2	-22.5	6.2	6.0	6.4	-38.1
Colorectal	43.9	35.4	54.0	35.2	34.6	35.8	24.7 *	35.0	34.5	35.4	25.6 *
Liver / intrahepatic bile duct	2.4	1.0	5.7	3.7	3.5	3.9	-34.9	4.7	4.5	4.9	-48.3
Pancreas	10.7	7.0	16.0	12.5	12.2	12.9	-14.8	12.4	12.1	12.7	-14.0
Larynx	2.6	1.0	6.0	1.4	1.2	1.5	92.9	1.3	1.2	1.4	108.8
Lung and bronchus	68.8	58.9	80.3	62.2	61.4	63.0	10.7	54.1	53.5	54.6	27.3 *
Melanoma of the skin	19.5	13.9	27.0	19.0	18.6	19.5	2.7	14.6	14.3	14.9	33.8
Breast	142.5	127.0	159.5	138.1	136.8	139.3	3.2	131.3	130.3	132.2	8.5
Cervix Uteri	6.0	2.6	11.7	6.7	6.4	7.1	-11.0	7.7	7.4	7.9	-21.9
Corpus uterus and uterus, NOS	25.2	19.1	32.8	31.9	31.4	32.5	-21.1	31.5	31.0	31.9	-19.9
Ovary	11.0	6.8	17.1	12.6	12.3	13.0	-12.8	12.4	12.1	12.7	-10.9
Urinary bladder (incl. in situ)	11.6	7.6	17.1	12.5	12.1	12.8	-7.2	10.6	10.3	10.9	9.1
Kidney and renal pelvis	14.8	10.2	21.0	11.9	11.6	12.3	24.1	10.9	10.6	11.2	35.9
Brain and other nervous system	13.3	8.2	20.2	6.2	5.9	6.4	115.4 *	5.6	5.4	5.8	135.1 *
Thyroid	39.2	30.1	50.3	28.6	28.0	29.3	37.0 *	29.0	28.6	29.5	35.0 *
Hodgkin lymphoma	2.4	0.6	6.3	2.9	2.7	3.2	-19.4	2.9	2.8	3.1	-18.0
Non-Hodgkin lymphomas	23.1	17.4	30.4	18.4	18.0	18.9	25.3	17.8	17.4	18.1	30.1
Myeloma	6.7	3.9	11.1	6.1	5.8	6.4	10.2	6.6	6.4	6.8	1.3
Leukemia	18.9	13.4	26.1	13.7	13.3	14.1	37.5	12.7	12.4	13.0	48.5 *

[1] Incidence rates (per 100,000 persons) are age-adjusted to the 2000 US standard population

[2] Data Source: NYS Cancer Registry

** Significant at $p<0.05$ level when comparing Warren County to NYS excl. NYC or NYS*

Table A-II-4 Estimates (with 95% Confidence Intervals) of Health Behavior and Lifestyle Indicators by Age Category among Males in Warren County and New York State excluding New York City, New York State Expanded Behavioral Risk Factor Surveillance System, 2013-2014 and 2016 Combined [#]

Indicator	Age Cat. (years)	Warren County					NYS excl. NYC			
		Total N	Percent	LCI	UCI		Total N	Percent	LCI	UCI
Overweight or Obese										
	20-49	157	67.9	57.3	78.6	^	8,205	68.5	66.4	70.6
	50-64	139	63.3	44.7	81.9	^	8,274	79.0	77.1	80.8
	65+	140	77.6	69.6	85.6		8,115	72.4	70.1	74.7
	50-74	230	69.1	55.1	83.0	^	13,197	78.1	76.5	79.7
	75+						3,192	67.6	63.9	71.2
Obese										
	20-49	157	30.3	21.4	39.3		8,205	28.1	26.2	30.1
	50-64	139	24.5	13.9	35.1	^	8,274	34.5	32.1	36.8
	65+	140	27.5	17.7	37.2		8,115	25.1	23.1	27.2
	50-74	230	25.8	17.5	34.0		13,197	32.6	30.7	34.4
	75+						3,192	21.2	17.8	24.6
Current Smoker										
	20-49	153	27.0	17.4	36.6		8,137	23.8	21.9	25.7
	50-64	139	22.9	12.5	33.3	^	8,212	20.4	18.4	22.3
	65+	136	10.7	5.1	16.3		7,980	6.6	5.6	7.5
	50-74	228	19.7	12.4	27.0		13,058	17.1	15.6	18.6
	75+						3,134	3.3	2.3	4.2
Binge Drinker										
	20-49	150	30.6	21.3	39.9		7,927	30.8	28.7	32.8
	50-64	136	26.0	15.0	37.1	^	8,010	18.3	16.3	20.3
	65+						7,819	7.2	6.0	8.4
	50-74	225	20.0	12.8	27.3		12,769	15.5	14.0	17.0
	75+						3,060	5.1	3.5	6.6
Gets Leisure Time Physical Activity										
	20-49	159	80.0	71.6	88.4		8,351	77.6	75.7	79.4
	50-64	141	80.1	70.4	89.9		8,389	73.9	71.6	76.1
	65+	140	72.5	61.7	83.2	^	8,152	71.4	69.1	73.7
	50-74	232	80.3	72.9	87.6		13,347	74.6	72.8	76.3
	75+						3,194	64.5	60.7	68.2
Has Health Care Coverage (among 18-64 years old)										
	20-49	159	84.3	76.0	92.7		8,473	82.1	80.3	83.8
	50-64	142	96.2	92.9	99.5	*	8,484	91.2	89.6	92.7
Fully Met USPSTF CCSRs (among 50-75 years old)										
	50-64	131	55.7	37.5	73.9	^	7,767	63.8	61.2	66.3
	65+	89	90.9	84.7	97.1	*	4,900	81.4	79.0	83.7

 # Estimates with <10 respondents in the numerator or <50 in the denominator were suppressed

^ High-variability estimate (i.e., having confidence limits greater than ±10%)

** Significantly different at $p<0.05$ level when comparing Warren County to NYS excl. NYC*

USPSTF CCSRs: U.S. Preventive Services Task Force Colorectal Cancer Screening Recommendations

Table A-II-5 Estimates (with 95% Confidence Intervals) of Health Behavior and Lifestyle Indicators by Age Category among Females in Warren County and New York State excluding New York City, New York State Expanded Behavioral Risk Factor Surveillance System, 2013-2014 and 2016 Combined [#]

Indicator	Age Cat. (years)	Warren County					NYS excl. NYC			
		Total N	Percent	LCI	UCI		Total N	Percent	LCI	UCI
Overweight or Obese										
	20-49	128	58.7	47.4	70.1	^	8,786	52.7	50.5	54.9
	50-64	151	63.0	52.5	73.4	^	9,916	61.9	59.7	64.1
	65+	171	68.0	59.9	76.1		11,601	59.4	57.3	61.5
	50-74	246	65.0	57.1	72.9		16,107	62.8	61.1	64.6
	75+	76	66.4	54.1	78.6	^	5,410	53.5	50.5	56.6
Obese										
	20-49	128	34.6	23.0	46.2	^	8,786	26.0	24.1	27.9
	50-64	151	35.7	22.9	48.5	^	9,916	29.1	27.2	31.0
	65+	171	29.7	20.9	38.5		11,601	25.2	23.4	27.0
	50-74	246	33.7	24.1	43.4		16,107	29.4	27.9	31.0
	75+	76	30.0	16.2	43.8	^	5,410	19.9	17.5	22.3
Current Smoker										
	20-49	138	27.3	17.9	36.7		9,570	18.6	17.1	20.2
	50-64	160	19.8	12.6	27.0		10,624	16.0	14.6	17.4
	65+	178	11.1	4.4	17.8		12,089	7.5	6.4	8.5
	50-74	261	18.5	12.5	24.5		17,168	14.1	13.0	15.1
	75+						5,545	5.3	3.8	6.9
Binge Drinker										
	20-49	135	16.6	9.8	23.4		9,397	18.1	16.5	19.7
	50-64	160	9.4	4.1	14.8		10,454	10.0	8.7	11.4
	65+						11,917	3.0	2.2	3.7
	50-74	260	7.9	4.0	11.9		16,921	8.3	7.3	9.3
	75+						5,450	1.6	0.9	2.2
Gets Leisure Time Physical Activity										
	20-49	143	85.9	79.1	92.7	*	9,815	74.8	72.9	76.6
	50-64	165	74.4	66.6	82.2		10,804	74.1	72.2	75.9
	65+	183	69.0	60.5	77.6		12,340	64.9	62.9	66.9
	50-74	269	74.5	68.1	81.0		17,484	73.2	71.6	74.7
	75+	79	62.7	49.6	75.7	^	5,660	58.1	55.1	61.0
Has Health Care Coverage (among 18-64 years old)										
	20-49	144	94.8	91.2	98.5	*	9,963	89.1	87.7	90.5
	50-64	169	94.4	90.4	98.3		10,932	94.5	93.7	95.4
Fully Met USPSTF CCSRs (among 50-75 years old)										
	50-64	153	72.8	64.4	81.3		10,099	67.6	65.4	69.7
	65+	108	78.5	69.3	87.7		6,642	80.5	78.3	82.7

 # Estimates with <10 respondents in the numerator or <50 in the denominator were suppressed

^ High-variability estimate (i.e., having confidence limits greater than ±10%)

** Significantly different at $p<0.05$ level when comparing Warren County to NYS excl. NYC*

USPSTF CCSRs: U.S. Preventive Services Task Force Colorectal Cancer Screening Recommendations

Table A-II-6 Prevalence (with 95% Confidence Intervals) of Current Smoker and/or Binge Drinker by Sex and Age Category for Warren County and New York State excluding New York City, New York State Expanded Behavioral Risk Factor Surveillance System, 2013-2014 and 2016 Combined[#]

Sex	Age Cat. (years)	Current Smoker	Binge Drinker	Warren County			NYS excl. NYC		
				Percent	LCI	UCI	Percent	LCI	UCI
Male									
	20-49	Yes	Yes	12.7	5.6	19.8	9.2	7.9	10.5
		Yes	No	14.1	6.3	21.8	14.5	12.9	16.0
		No	Yes	16.9	10.3	23.6	20.4	18.7	22.2
		No	No	56.3	46.0	66.6	55.9	53.7	58.1
	50-64	Yes	Yes	9.1	3.1	15.2	5.4	4.1	6.7
		Yes	No	13.7	5.5	21.9	14.9	13.3	16.5
		No	Yes	15.8	7.7	23.8	12.4	10.8	13.9
		No	No	61.4	47.5	75.2	67.3	65.0	69.6
	65+	Yes	Yes	0.4	0.0	1.1	0.9	0.6	1.1
		Yes	No	10.2	4.8	15.7	5.7	4.8	6.6
		No	Yes	6.3	2.1	10.5	6.2	5.0	7.3
		No	No	83.1	76.2	90.0	87.3	85.8	88.7
Female									
	20-49	Yes	Yes	4.8	1.2	8.4	4.8	3.9	5.6
		Yes	No	22.4	13.5	31.2	13.8	12.5	15.2
		No	Yes	11.3	5.8	16.7	12.9	11.5	14.2
		No	No	61.6	51.1	72.1	68.6	66.7	70.4
	50-64	Yes	Yes	3.1	0.1	6.1	2.9	2.2	3.6
		Yes	No	16.7	9.9	23.4	13.1	11.8	14.3
		No	Yes	6.3	1.8	10.9	6.9	5.7	8.0
		No	No	73.9	65.9	81.9	77.1	75.4	78.8
	65+	Yes	Yes	1.0	0.0	3.0	0.4	0.2	0.6
		Yes	No	10.0	3.6	16.4	7.0	6.0	8.0
		No	Yes	2.0	0.3	3.8	2.5	1.8	3.2
		No	No	86.9	80.2	93.7	90.1	88.8	91.3

[#] Respondents who didn't provide valid answers on questions used to generate both "current smoker" and "binge drinker" indicators were excluded from analysis. Responders who provided valid answers only on questions used to generate indicator "current smoker" were counted as "not binge drinker". Responder, who provided valid answers only on questions used to generate indicator "binge drinker" were counted as "not current smoker".

Table A-II-7 Occupation for Civilian Employed Population 16 Years and Over in Warren County, New York State excluding New York City, and New York State, 2011-2015 American Community Survey

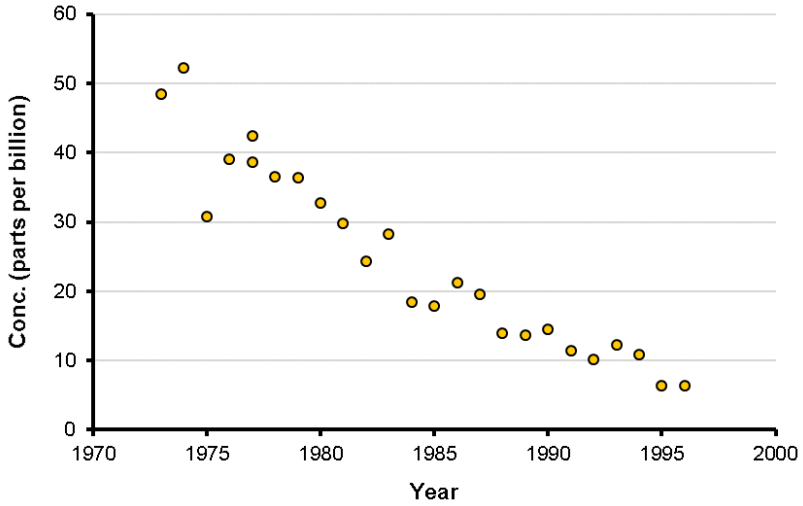
Occupation Category	Warren County		NYS excl. NYC		NYS	
	Estimate	Percent	Estimate	Percent	Estimate	Percent
Management, business, science, & arts occupations	11,318	35.5	2,078,659	39.0	3,627,956	39.2
Management, business, & financial occupations	4,107	12.9	768,505	14.4	1,363,862	14.7
Management occupations	2,895	9.1	519,460	9.8	891,755	9.6
Business & financial operations occupations	1,212	3.8	249,045	4.7	472,107	5.1
Computer, engineering, & science occupations	1,246	3.9	254,059	4.8	418,516	4.5
Computer & mathematical occupations	492	1.5	118,674	2.2	213,778	2.3
Architecture & engineering occupations	482	1.5	88,758	1.7	124,825	1.3
Life, physical, & social science occupations	272	0.9	46,627	0.9	79,913	0.9
Education, legal, community service, arts, & media occupations	3,821	12.0	703,355	13.2	1,297,321	14.0
Community & social services occupations	845	2.7	107,475	2.0	186,735	2.0
Legal occupations	335	1.1	80,594	1.5	161,759	1.7
Education, training, & library occupations	2,157	6.8	416,371	7.8	664,350	7.2
Arts, design, entertainment, sports, & media occupations	484	1.5	98,915	1.9	284,477	3.1
Healthcare practitioner & technical occupations	2,144	6.7	352,740	6.6	548,257	5.9
Health diagnosing/treating practitioners & other technical occupations	1,354	4.2	249,411	4.7	392,210	4.2
Health technologists & technicians	790	2.5	103,329	1.9	156,047	1.7
Service occupations	6,218	19.5	973,173	18.3	1,879,463	20.3
Healthcare support occupations	585	1.8	136,864	2.6	323,412	3.5
Protective service occupations	877	2.8	151,021	2.8	261,833	2.8
Firefighting, prevention, & other protective service workers incl. supervisors	440	1.4	69,149	1.3	142,878	1.5
Law enforcement workers including supervisors	437	1.4	81,872	1.5	118,955	1.3
Food preparation & serving related occupations	2,067	6.5	280,406	5.3	514,919	5.6
Building & grounds cleaning & maintenance occupations	1,480	4.6	206,396	3.9	387,264	4.2
Personal care & service occupations	1,209	3.8	198,486	3.7	392,035	4.2

Table A-II-7 Occupation for Civilian Employed Population 16 Years and Over in Warren County, New York State excluding New York City, and New York State, 2011-2015 American Community Survey (*Cont.*)

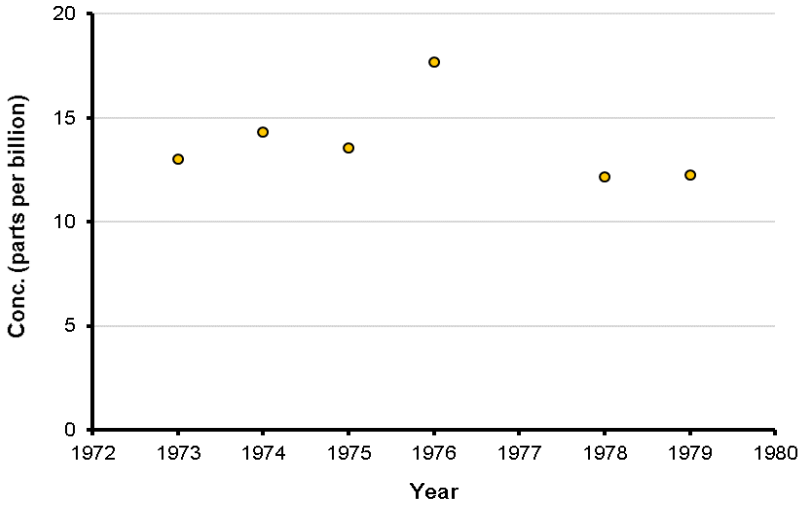
Occupation Category	Warren County		NYS excl. NYC		NYS	
	Estimate	Percent	Estimate	Percent	Estimate	Percent
Sales & office occupations	7,778	24.4	1,302,716	24.5	2,198,961	23.8
Sales & related occupations	3,876	12.2	573,308	10.8	976,258	10.5
Office & administrative support occupations	3,902	12.2	729,408	13.7	1,222,703	13.2
Natural resources, construction, & maintenance occupations	2,656	8.3	431,817	8.1	673,298	7.3
Farming, fishing, & forestry occupations	117	0.4	20,238	0.4	23,041	0.2
Construction & extraction occupations	1,739	5.5	254,011	4.8	418,702	4.5
Installation, maintenance, & repair occupations	800	2.5	157,568	3.0	231,555	2.5
Production, transportation, & material moving occupations	3,896	12.2	538,362	10.1	874,900	9.5
Production occupations	1,837	5.8	253,903	4.8	362,614	3.9
Transportation occupations	1,281	4.0	180,913	3.4	353,781	3.8
Material moving occupations	778	2.4	103,546	1.9	158,505	1.7
Total	31,866		5,324,727		9,254,578	

Figure A-II-1 Historical Trends for Criteria Air Pollutant Concentrations at Warren County Monitoring Location: Radio Station WWSC, Dix Avenue

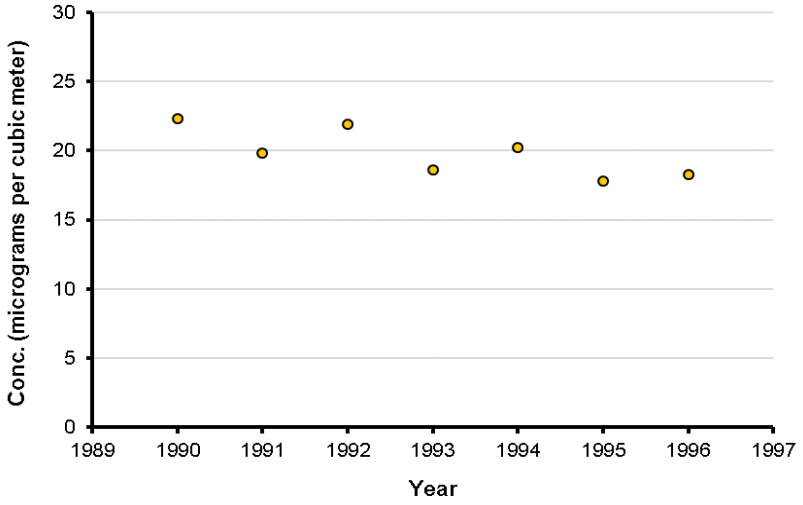
(A) Sulfur Dioxide Annual Average Concentration, 1973-1996



(B) Nitrogen Dioxide Annual Average Concentration, 1973-1979



(C) Particulate Matter (<10 microns) Annual Average Concentration, 1990-1996



There is not currently a NAAQS based on annual-averages for sulfur dioxide.

There is not currently a NAAQS based on annual-averages for nitrogen dioxide.

The current NAAQS for PM_{10} is 150 mcg/m^3.

NAAQS: National Ambient Air Quality Standard

Table A-II-8 Summary of Industrial and Inactive Hazardous Waste Disposal Sites in Warren County

Site Name	Site Code	Note
36 Elm Street	E557019	Historical uses included shirt and lingerie production, auto repair, housing and, most recently a warehouse for a restaurant supply company. The site is currently unoccupied. The various commercial activities and operation of an oil-fired heating system resulted in the disposal of hazardous substances, including volatile organic compounds (VOCs), semi-volatile organic compounds (SVOCs), and inorganics (metals). These hazardous substances contaminated the subsurface soils and groundwater at the site at very low levels. Standing water found in an on-site building's basement was found to contain polycyclic aromatic hydrocarbons (PAHs) and metals including arsenic, cadmium, lead, selenium and mercury. Measures are currently in place to control for coming in contact with any contaminated groundwater or subsurface soils.
Bay Road Duck Pond	557018	The Bay Road Duck Pond is a half-acre pond in Queensbury. Polychlorinated biphenyl (PCB) oil obtained from General Electric (GE) by an employee was applied to the pond for weed control. All contaminated sediment was removed from the pond by the GE Corporation and disposed of offsite. The downstream area was investigated by the DEC and no further action was required. A fish study was conducted in the downstream creek and PCBs were not detected at concentrations requiring any further health advisory.
Barton Mines	557008	Barton Mines is an industrial garnet mining operation wherein approximately 0.5 cubic yards of demolition material is disposed of daily. No known hazardous wastes have been disposed of at this site.
Ciba-Geigy Main Plant/Pre-treatment Plant	557011	This site, located in Queensbury, has a history of industrial and manufacturing activities dating back to 1901. The Ciba-Geigy plant site manufactured paints and pigments, printing inks, plastics, fibers and other items. Prior to 1973, industrial liquid wastes were discharged into the Hudson River. In 1983, industrial wastewater was discharged to the publicly-owned treatment works facility until facility closure in 1989. During past site activities, airborne particulates had also been released from the facility. Site operations impacted soils, Hudson River sediments and groundwater primarily with metals (arsenic, cadmium, chromium, lead, mercury, and/or barium) and cyanide. Volatile and semi-volatile organic compounds have also been detected within limited areas on-site. Since 1973, various activities have been performed to reduce impacts of site contamination on the environment by modifying site operations and performing interim corrective measures. From 2000 to 2004 corrective measures were performed to address contamination within soils, Hudson River sediments, and groundwater. Contaminated soils and Hudson River sediments were excavated and located beneath an impermeable or permeable cover on-site. The general public was restricted from entering the site and only occupational workers had the potential for exposure on-site. A deed notice was placed on the property, which indicates the site is suitable for industrial use, groundwater should not be used, and site management activities be conducted. The corrective measures conducted for the site, as well as the dredging activities performed by others, have significantly reduced sediment contamination in the Hudson River.

Table A-II-8 Summary of Industrial and Inactive Hazardous Waste Disposal Sites in Warren County (*Cont.*)

Site Name	Site Code	Note
Ciba-Geigy (Hercules)	557004	This site was used for disposal of hazardous waste sludge from Ciba-Geigy's manufacturing processes located in nearby Glens Falls, NY. An adjacent surface impoundment was used to collect leachate from the landfill cell and runoff from a truck washing station. The hazardous waste landfill is a regulated unit and was closed during 1990. As a direct result of closure of the landfill cell, dramatic reduction in leachate generation and the concentration of hazardous constituents in the leachate have resulted. Groundwater concentrations also significantly responded to the landfill closure and they have now remained at levels below groundwater protections standards for many years.
Econo Quick Gas & Car Wash Property	E557021	This site, located in Warrensburg, served as a gas station and a car wash since 1970. The site is adjacent to Warrensburg Laundry and Dry Cleaning. Underground storage tanks were removed upon direction from DEC in 1999. Following tank removal, significant gasoline contamination was found in the tank areas. Initial spill response addressed the majority of the gasoline contamination. Following this work, the Town of Warrensburg entered the Brownfield program, investigated the site, and removed some additional contaminated soil, resulting in a no further remedial action required determination. Currently, the area is served by public water and there is a notice in place to inform future property owners of a potential soil vapor intrusion concern if the site is redeveloped with a building.
Finch, Pruyn and Company	557002	In Queensbury, Finch, Pruyn and Company dumped paper mill sludge at an active landfill on Route 149. There are groundwater monitoring wells at this site and the sludge was found to be non-hazardous. There are no residential exposures associated with this landfill.
Glens Falls Landfill	557003	The Glens Falls Municipal Landfill Site is located in Queensbury. This site has been an active transfer station since January 1977. The City of Glens Falls operated the Glens Falls Municipal Landfill as a municipal solid waste (MSW) landfill for approximately 16 years from 1961 to 1977. It has been reported that the landfill was used primarily for disposal of municipal refuse, but an unknown quantity of PCB capacitors may have been deposited at this landfill. Several investigations and DEC enforcement actions have occurred and remediation of the site is complete. Prior to remediation, the primary contaminants of concerns were PAHs in the surface soil and PCBs in the groundwater.
Glens Falls Range	557023	The Glens Falls Range is a former small arms range and munitions response site (MRS) located in Glens Falls that was operational from 1878 to 1955. Based on site investigations, lead in surface soils exceed health-based soil criteria. No munitions and explosives of concern were observed at the site. The Glens Falls Range MRS was recommended by the National Guard (with State concurrence) for a Remedial Investigation/Feasibility Study for munitions constituents. The National Guard has not received funding to initiate the Remedial Investigation. We have no information onl the likelihood of potential exposure to any site contaminants.

Table A-II-8 Summary of Industrial and Inactive Hazardous Waste Disposal Sites in Warren County (*Cont.*)

Site Name	Site Code	Note
Halfway Creek Fish Study	557017	The unnamed stream draining Bay Road Duck Pond is a tributary of Halfway Creek. Halfway Creek enters the Champlain Canal near Fort Ann, NY. Halfway Creek is stocked with brook trout by the Warren County fish hatchery and is actively fished by local residents. Previous sampling data for the Bay Road Duck Pond indicate that the site is contaminated with PCBs. It is believed that PCB oil was used at one time at the site as a means of controlling weed growth in the duck pond. The primary objective of investigations was to determine if the known contamination has resulted in an impact to the sediments and fish population in Halfway Creek and the small tributary of Halfway Creek which serves as an outlet for the duck pond. All sediment sample results were less than 1 ppm of PCBs which did not trigger additional remedial actions. Although PCBs were detected in the fish samples at concentrations from 100 to 590 parts-per-billion (ppb), these concentrations would not require any fish advisory other than the DOH's general fish advisory. The general health advisory for sportfish in NYS is that you eat no more than one meal (one-half pound) per week of fish taken from the state's freshwaters and some marine waters at the mouth of the Hudson River.
Hudson River	546031	The Hudson River runs through Warren County, entering at North River and forming the southern and south-western boundaries of the county at Hudson Falls' boundary. This river served as an important transportation route to support commerce since the Industrial Revolution. In 1984, 200 miles of the river, between Hudson Falls and the Battery in NYC, was placed on EPA's National Priorities List of the country's most contaminated hazardous waste sites, because during a 30-year period PCBs were discharged from two General Electric capacitor manufacturing plants located in Hudson Falls and Fort Edward. Once the PCBs entered the river system, they contaminated river sediments, the river bottom, and in some areas along the shoreline of the river floodplain. PCBs build up in the environment and contaminate river biota. The primary human health risk associated with PCB pollution in the river is through the consumption of contaminated fish; people can also be exposed to PCBs via direct contact with contaminated sediments and soils. According the EPA, PCBs are considered probable human carcinogens and are linked to other adverse health effects such as low birth weight, thyroid disease, and learning, memory, and immune system disorders. PCBs in the river sediment also affect fish and wildlife. Because of site impacts, most fish from the Hudson River downstream of Hudson Falls have elevated PCB levels. Fishing is restricted to catch and release in this region, with a "eat none" advisory for fish consumption, from Hudson Falls to Troy. In addition, there are advisories ("eat none" or "eat no more than 1 meal per month") on consumption of several fish species caught from the Hudson River below the Troy Dam to New York Harbor. People may contact PCB contaminants present in the shallow river sediments while entering or exiting the river during recreational activities, and may also contact contaminants present in floodplain soils. This direct contact route of exposure is present primarily in the Hudson between Hudson

Table A-II-8 Summary of Industrial and Inactive Hazardous Waste Disposal Sites in Warren County (*Cont.*)

Site Name	Site Code	Note
		Falls and Troy but not in the Warren County portion of the river. GE under EPA and State oversight has taken actions at several properties along the Hudson River to address PCB-contaminated floodplain soils between Hudson Falls and Troy. These actions vary from deploying signs to installing various covers, and are intended to reduce exposures to PCBs in floodplain soils until a permanent remedy is developed. Additionally, a remedial investigation to address floodplain soils in the Upper Hudson River Floodplain under EPA and State oversight is now underway. The following websites provide more information on the Hudson River Superfund Site: EPA: https://www3.epa.gov/hudson/; DEC: http://www.dec.ny.gov/chemical/8677.html; and DOH: https://www.health.ny.gov/environmental/outdoors/hudson_river/. Sportfish consumption health advisories for the Hudson River are available at: https://www.health.ny.gov/environmental/outdoors/fish/hudson_river/.
Luzerne Road Site	557010	This site located in Queensbury was historically a scrap and salvage yard for automobiles, machinery, and other industrial equipment. Salvaging operations of capacitor equipment performed from the 1950s through the 1970s on the northern portion of the property resulted in the discharge of PCBs to surface and subsurface soils. Associated capacitor salvaging operations also contaminated the backyards of private residences in a neighborhood approximately one mile to the west of the site. In 1979, DEC implemented an interim remedy to contain PCB-contaminated wastes until a suitable permanent remedy could be applied. PCB compounds in the subsurface soils contaminated the groundwater in the vicinity of this site. Exceedances of standards, criteria, and guidance include PCBs in the groundwater and soils above clean-up guidance values in the surface and subsurface soils. Groundwater monitoring wells were installed on-site and off-site in order to determine the concentrations in the PCB plume. The site presented a significant threat due to direct exposure to PCBs above clean-up guidance numbers and ongoing releases from sources areas (the subsurface soils) of PCB contamination into groundwater. In 2008, a final remedy for the site was implemented and completed in 2009. This involved excavation of the containment cell, off-site disposal of highly contaminated PCB waste debris and soils from the cell, and on-site thermal treatment of the less contaminated soils.
Niagara Mohawk MGP Glens Falls	557016	The Niagara Mohawk Glens Falls Former Manufactured Gas Plant (MGP) is in the City of Glens Falls, adjacent to the Glens Falls Feeder Canal. A manufactured gas plant operated at the site from 1854 to 1950. The site is currently owned by National Grid and had been used until late 2006 for maintenance and industrial operations. Feeder canal sediments were found to contain polycyclic aromatic hydrocarbons, volatile organic compounds (benzene, toluene, ethylbenzene, and xylene), cyanide, and metals (chromium, manganese, and nickel). The Feeder Canal is used for recreational purposes. In 2008, the site contaminants located in the canal were capped (in-situ) as part of an interim remedial measure. Prior to 2008, people could have come in direct contact (dermal) with contaminated sediments or via accidental ingestion of site-related contaminants.

Table A-II-8 Summary of Industrial and Inactive Hazardous Waste Disposal Sites in Warren County (*Cont.*)

Site Name	Site Code	Note
Niagara Mohawk – Queensbury	557012	The site is on property owned by Niagara Mohawk located in a rural area on Corinth Road along the north banks of the Hudson River. The property was leased for use as seasonal residences. There are no longer any structures on the site. An area of soil was contaminated either by dumping or filling with contaminated fill. Initial surface soil samples indicated elevated PCB levels on the river bank and on the river bottom adjacent to the shore. In 1996, Niagara Mohawk completed a pair of Interim Remedial Measures at the site involving the removal and proper disposal of contaminated soil from areas with high PCB levels. The intake at the Town of Queensbury public water supply is downstream. The water supply was monitored quarterly for many years, and no PCBs were detected. An annual fish sampling program from 1995 to 2005 showed a decrease of PCB levels in fish. There is no longer a special advisory against consumption of fish from the Sherman Island Pool. However, there is still the general "Eat None" advisory for women and children, and "one meal per month" for men over 15 years old. The need for future advisories will be evaluated based on results of ongoing monitoring. Remedial options to address remaining PCB contaminated sediments are being evaluated.
Northway Plaza Shopping Center	V00141	A portion of this shopping plaza in Queensbury was the site of automotive service centers and a convenient medical care office. Subsurface petroleum contamination of groundwater was discovered in 1998. A corrective action plan was implemented by the volunteer to address on-site contaminants which was completed in 2001. The area is served by public water.
Queensbury Landfill	557005	This municipal landfill receives waste from the Town of Queensbury. There are three distinct areas of the landfill: an active portion, an inactive portion, and a sand and gravel operation. Heavy metal sludge and PCB capacitors were believed to have been dumped here but no documentation was found. There are 25-30 homes within 2,000 feet of the site, all of which utilize groundwater for their drinking water source. Downgradient monitoring wells were sampled in 1981 and analysis revealed contamination by heavy metals and chlorinated compounds. DEC's Division of Solid Waste took actions to properly close and monitor the landfill.
Ridge Street Site	B00140	Located in the City of Glens Falls, this site was home to a gas station (1930s-1960s) , a municipal fire station (prior to the gas station) and a pizza parlor (1975-1993). In 1989, a petroleum spill was reported and two underground storage tanks were found. The tank contents were removed and the tanks were cleaned and filled with concrete. In 2000, the tanks and building have been removed and the site is used as a municipal parking lot. Subsurface soils in the tank pit area contained gasoline related chemicals. People are unable to contact site contaminants due to pavement cover.

Table A-II-8 Summary of Industrial and Inactive Hazardous Waste Disposal Sites in Warren County (*Cont.*)

Site Name	Site Code	Note
Sherman/Luzerne	557015	The site is located between Sherman Avenue and Luzerne Road in the Town of Queensbury. Cores from stripped capacitors were found in a cleared area several acres in size. Each core had a dark stain surrounding it in the soil and there was a PCB odor in that area. The capacitor cores were unearthed during clearing and earth-moving activities. The cores observed are typical of five-gallon PCB units. Intact, one-gallon size capacitors were also present at the site. Sample results confirmed high levels of PCBs in soils at the site. A Record of Decision (ROD) was signed on March 31, 1997 and called for the delineation and removal of the PCB contaminated soils at the site. The ROD also called for the excavated soils to be shipped to an acceptable disposal facility and the excavated areas to be back-filled, graded and seeded. Remedial activities at the site has been completed and the site has been delisted. The area near the site is used by off-road vehicles. However, the removal of contaminated soils has eliminated potential exposures to PCB material. The area is served by public water. Two homes identified as still using wells have been sampled and no contamination was detected. Prior to site cleanup, people could have come into contact with contaminated soils and the capacitor cores that were dumped on-site.
USCI - CR Bard Inc.	557007	The USCI facility developed and manufactured medical catheters for the health care industry. During the manufacturing process, wastewaters are generated which vary in their degree of toxicity and corrosiveness. Areas of concern were alleged buried drums (although no drums were found on the site) and septic tanks and leach systems into which the facility previously discharged. The facility was connected to the Town of Queensbury sewer system in April 1988. All permitted sewage is discharged to this system. Septic tanks and leach systems were decommissioned and removed. Highly contaminated soils in the leaching pits at this site were removed in 1989. Investigation of possible additional contamination has shown that no other problems are present and no further action is needed. Phase I and II investigations have been completed. The remediation of this site is complete, no further action is necessary (site was delisted in 1991).
Warrensburg Board and Paper	E557020	Former paper operations and poor chemical management at this site may have contributed to onsite and offsite petroleum contamination. Petroleum products were found to be leaking into the Schroon River, where people could contact the chemicals. Emergency removal actions, including removal of drums and contaminated soil, in 1995 and 2000 eliminated this potential exposure pathway. A 2007 investigation found no hazardous substances remained onsite and it no longer poses an environmental threat.
Warrensburg Board & Paper Mill Parcel	557006	This site was used as a landfill to dispose of waste paper, wood and metal from the Warrensburg Board and Paper mill operations. The landfill also received municipal waste and there were some concerns about possible illegal dumping in 1978-1979. An environmental investigation did not detect any evidence of hazardous waste at the site.

Table A-II-8 Summary of Industrial and Inactive Hazardous Waste Disposal Sites in Warren County (*Cont.*)

Site Name	Site Code	Note
Warrensburg Laundry & Dry Cleaning, Inc.	557022	Laundry and dry-cleaning operations began in 1956 at this site. During an investigation of a gasoline plume from the adjacent Econo Quick Gas, gasoline products (benzene, toluene, ethyl xylene, xylenes (collectively known as BTEX), and methyl-tert-butyl ether (MTBE)) as well as dry cleaning chemicals (tetrachloroethene and trichloroethene) were found in the water from the on-site supply well that was used for drinking water at the second-floor apartments and for laundry operations. In response to this investigation, the apartments were connected to public drinking water and the on-site well was just used for laundry operations. Soil gas was also found to have elevated levels of tetrachloroethene and a sub-slab depressurization system was installed to mitigate any vapors from entering the building

For additional information about any of these sites listed in the table, people can contact DOH staff at (518) 402-7860 or visit the DEC environmental site remediation database website at https://www.dec.ny.gov/cfmx/extapps/derexternal/index.cfm?pageid=3 and enter the site code provided in the table.

Appendix III – Additional Concerns and Issues Raised by Stakeholders and the Public

Perceived High Incidence of Female Breast Cancer

From 1996 through 2015, the annual incidence rate of female breast cancer for Warren County varied substantially over time, but in general was comparable to the rates for both NYS excluding NYC and NYS (Fig. A-III-1). In the most recent decade, the rate seems to be increasing for all three regions. However, the upward trend was statistically significant only for NYS.

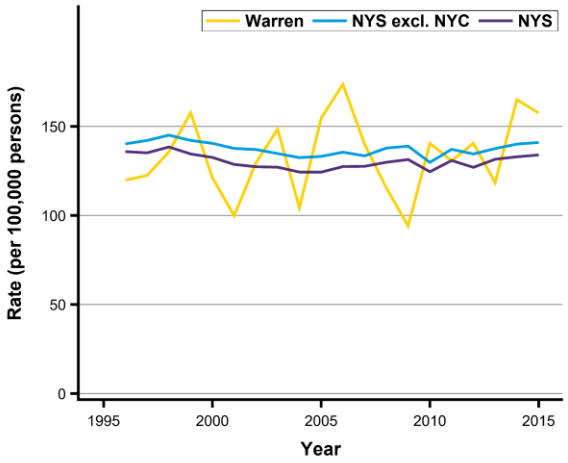
The female breast cancer rate in Warren County between 2011 and 2015 was 142.5 per 100,000 persons, comparable to the rates of 138.1 in NYS excluding NYC and 131.3 in NYS (Table A-II-3). Moreover, the distribution of cases by age group for Warren County was similar to that for both NYS excluding NYC and NYS (Table A-III-1). For each age group examined, the respective incidence rate for Warren County was similar to the rates for both NYS excluding NYC and NYS (Fig. A-III-2).

In addition to analyzing malignant invasive female breast cancers, on which routine

Table A-III-1 Distribution (%) of Female Breast Cancer Cases by Age Group for Warren County, New York State excluding New York City, and New York State, 2011-2015

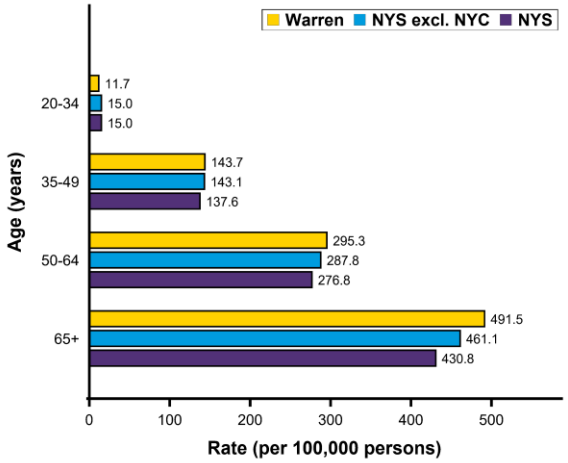
Age Group (years)	Warren County	NYS excl. NYC	NYS
20-34	0.9	1.4	1.9
35-49	14.4	17.0	18.1
50-64	35.5	36.1	36.1
65+	49.3	45.5	43.8

Figure A-III-1 Female Breast Cancer Incidence Rates[1] for Warren County, New York State excluding New York City, and New York State, 1996-2015



[1] Incidence rate was age-adjusted to the 2000 US standard population.

Figure A-III-2 Female Breast Cancer Incidence Rates[1] by Age Group for Warren County, New York State excluding New York City, and New York State, 2011-2015



[1] Incidence rate was age-adjusted to the 2000 US standard population.

cancer incidence reports are based, we examined the incidence of *in-situ* breast tumors. The results show no elevation for any group in Warren County when compared to both NYS excluding NYC and NYS (Table A-III-2).

Table A-III-2 Incidence Rates[1] of Female *in-situ* Breast Tumors by Age Group for Warren County, New York State excluding New York City, and New York State, 2011-2015

Age Group (years)	Warren County	NYS excl. NYC	NYS
20-34	0.0	1.9	2.0
35-49	54.2	59.1	59.3
50-64	104.8	104.9	103.0
65+	76.9	102.9	103.1

[1]*Incidence rate was age-adjusted to the 2000 US standard population.*

Based on the reports received at the NYSCR, Warren County females of every age group were diagnosed with breast cancer at rates that were comparable to rates in NYS excluding NYC and in NYS as a whole.

The NYSCR collects the residential address at the time of cancer diagnosis, but only the state of residence at birth. For patients who were born in NYS and were diagnosed with cancer while residing in another state, their cancer information would not have been reported to the NYSCR. The NYSCR is only authorized to receive cancer reports on residents of NY and on non-NY residents who were either diagnosed or treated in NY. Therefore, it was not possible for this study to evaluate whether women born in Warren County (and especially not in a specific area in Warren County) experienced a higher rate of breast cancer. This is an example of the limitation due to population migration discussed in 'Section 14 – Limitations'.

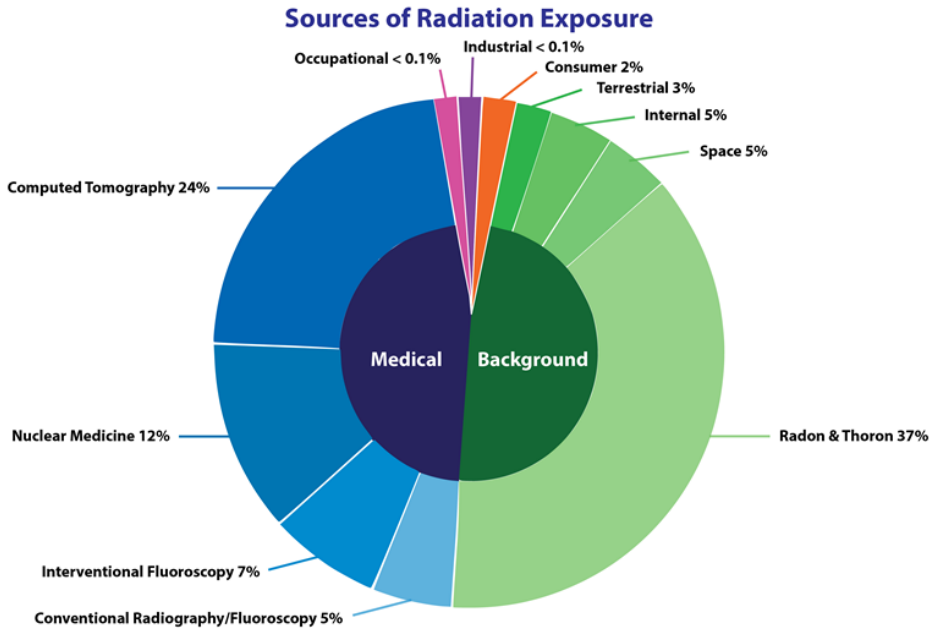
Radiation Exposure

Human beings are exposed to natural background radiation every day from the ground, building materials, air, food, the universe, and even elements in their own bodies. In the United States, most exposure to background ionizing radiation comes from exposure to radon gas and its decay products. The other major source of radiation exposure to the public is medical procedures (x-rays, CT scans, etc.). The average annual radiation dose to the US population is approximately 620 millirem (6.2 millisievert) and is broken down by category in Figure A-III-3.

The numbers reflected in the graph are averages; individual exposures will vary. Factors that might increase exposure to ionizing radiation include (1) increased uses of radiation for medical purposes, (2) occupational exposure to radiation, and (3) smoking tobacco products. Factors that might decrease radiation exposure include living at lower altitudes (less cosmic radiation) and living and working in the higher floors of a building (less radon).

One challenge to understanding the health effects of radiation is that there is no general property that makes the effects of man-made radiation different from those of naturally occurring radiation. Still another difficulty is that of distinguishing cancers that occur because of radiation exposure from cancers that occur due to other causes.

Figure A-III-3 Source of Radiation Exposure and Average Annual Radiation Dose



Average Annual Radiation Dose

Sources	Radon & Thoron	Computed Tomography	Nuclear Medicine	Interventional Fluoroscopy	Space	Conventional Radiography/ Fluoroscopy	Internal	Terrestrial	Consumer	Occupational	Industrial
Units											
mrem (United States)	228 mrem	147 mrem	77 mrem	43 mrem	33 mrem	33 mrem	29 mrem	21 mrem	13 mrem	0.5 mrem	0.3 mrem
mSv (International)	2.28 mSv	1.47 mSv	0.77 mSv	0.43 mSv	0.33 mSv	0.33mSv	0.29 mSv	0.21 mSv	0.13 mSv	0.005 mSv	0.003 mSv

(Source: National Council on Radiation Protection & Measurements, Report No. 160)

The most thoroughly studied individuals for the determination of the health effects of exposure to ionizing radiation are the survivors of the Hiroshima and Nagasaki atomic bombs. Increased cancer rates have been seen at radiation dose levels of about 10 to 400 rem (100 to 4000 millisievert), or about 40 to 1600 times the average yearly background exposure.

At a radiation dose of 10 rem (100 millisievert), approximately 1 person in 100 would be expected to develop cancer, while approximately 42 of the 100 individuals would be expected to develop cancer from other causes. Lower radiation doses would produce proportionally lower risks, i.e., approximately one individual per thousand would develop cancer from an exposure to 10 millisievert.

Appendix IV – Detailed Description of Available Data Sources Used for Environmental Data Review

Sources of Data for Air Quality Evaluation

Background

An air pollutant is a substance (such as a chemical, dust, smoke, or pollen) that is present in air as a solid (particulate), gas (vapor) or liquid (mist), or a combination of these. Air pollution is the presence of those substances in the air at levels (concentrations) greater than would normally be found or considered desirable. Air pollution comes from many different man-made sources such as cars, buses, trucks, factories, power plants and dry cleaners, as well as natural sources such as vegetation, windblown dust, and wildfires. Although air pollution is typically thought of as an outdoor air problem, sources also exist inside homes and places of work. Examples include tobacco smoke, home heating appliances, new carpeting, household products (such as air fresheners, paints, cleansers, and pest-control agents), and personal care products (such as perfumes, deodorants, lotions, and hair-care products).

New York State (NYS) developed an air pollution control program over 60 years ago. In 1957, the NYS Legislature enacted one of the nation's first comprehensive air pollution control laws by passing the Air Pollution Control Act, formerly Article 12-A of the Public Health Law. The Law recognized the need "to safeguard the air resources of the state from pollution" by controlling or abating air pollutant releases from existing sources and preventing new source releases for the public good. The State's policy was then and remains: "to maintain a reasonable degree of purity of the air resources of the state, which shall be consistent with public health and welfare and the public enjoyment thereof, the industrial development of the state…" By 1962 this policy provided the foundation for an air pollution control program to control emissions from industrial processes and the combustion of fuels in New York.

Since the 1970 Clean Air Act, the US Environmental Protection Agency (EPA) has been regulating "criteria" air pollutants which are carbon monoxide, nitrogen dioxide, sulfur dioxide, particulate matter, ozone, and lead through National Ambient Air Quality Standards (NAAQS). Two types of Standards were established. The Primary Standards are designed to protect human health with an adequate margin of safety, and Secondary Standards are designed to protect public welfare, including protection against decreased visibility and damage to animals, crops, and buildings. Additional information about criteria pollutants is available on the EPA's web site at https://www.epa.gov/criteria-air-pollutants.

In 1990, the Clean Air Act was amended to include a list of "hazardous air pollutants" selected by Congress based on potential health and/or environmental hazards. The original list included 188 hazardous air pollutants (HAPs) such as benzene, which is found in gasoline; tetrachloroethene (PERC), which is emitted from dry cleaning facilities; methylene chloride, which is used as a solvent and paint stripper; and some metals such as cadmium, mercury, and

chromium. The current list includes 187 HAPs. The Clean Air Act requires the EPA to regulate emissions of HAPs from a list of industrial sources called "source categories" (e.g., boat manufacturing, gasoline distribution, and municipal and hazardous waste combustors). Additional information about HAPs is available on the EPA's web site at: https://www.epa.gov/haps.

DEC establishes both short-term and long-term air concentration guideline values for toxic air pollutants (including the subset known as EPA-designated Hazardous Air Pollutants (HAPs)) by adopting the most health-protective, scientifically valid value developed by DEC, EPA, DOH or other authoritative agencies. DEC uses these values as part of its strategy to determine the degree of pollutant removal required for sources releasing toxic air pollutants. Short-term air concentration guideline values (SGCs) are derived to protect the general public from adverse exposure to toxic air pollutants during short-term exposures of 1 hour. Long-term (annual) guideline concentrations (AGCs) are derived to protect the general public from chronic health effects during a lifetime of continuous exposure.

Air Quality Monitoring Data

The EPA's **Air Quality System** database contains data from air quality monitoring stations across the state in operation at various locations and times since 1965. The database contains measurements for criteria pollutants as far back as early 1965 and toxic air pollutants starting in the late 1980s. DOH began the measurements of pollutants in New York State in the mid-1960s and DEC assumed responsibility for the air quality monitoring network after the agency was established in the early 1970s.

The criteria air pollutants measured include sulfur dioxide, ozone, carbon monoxide, nitrogen dioxide, and lead, total suspended particulates and particulate matter less than 2.5 and 10 microns ($PM_{2.5}$ & PM_{10}) in diameter. Even though toxicological data do not indicate that these pollutants are environmental risk factors for cancer, DOH researchers considered the criteria pollutants since they provide the longest historical measurements of air pollution. The criteria pollutants have been co-released with other air pollutants that could be potential carcinogens for which there are no historical measurements. Further work could be conducted to determine the utility of using historical measurements of criteria pollutants as surrogates or indicators of exposure to potential carcinogens. For the purposes of this evaluation, staff looked at trends over time for each of the criteria air pollutants.

DEC has been operating a statewide **Air Toxics Monitoring Network** since 1990. Currently, there are there are 11 sites statewide collecting 24-hour canister samples for a full suite of volatile organic chemicals in a 1 in 6-day interval. This network has measured air pollutants that are known or likely known to be human carcinogens which will be included in this assessment. The initial development of this network was part of the Staten Island/New Jersey Urban Air Toxics Assessment Project which began in 1987 on Staten Island. Information from this early study has been compiled for review as part of this Initiative. In some cases, monitor data may

not be available for the study areas. In these cases, staff reviewed and, where appropriate, summarized data from nearby monitors as an indicator of exposures in the study area. More information on DEC's air monitoring program and data can be found on-line at: http://www.dec.ny.gov/chemical/8406.html.

Air Quality Modeled Concentrations

The EPA estimated chemical-specific air concentrations for small geographic areas known as census tracts across the US. This program is called the **National-scale Air Toxics Assessment** (see: https://www.epa.gov/national-air-toxics-assessment). Over the years the number of EPA-designated HAPs included in the model has varied from 32 for the 1996 NATA to 180 plus diesel particulate matter for the 2014 NATA. EPA obtained emissions data (*i.e.*, for the years 2011 and 2014) from state sources, the Toxic Release Inventory, the National Emissions Inventory, and other databases. EPA developed outdoor air concentrations using a complex computer program (called a dispersion model) that merges the emissions data with meteorological data, such as wind speed and wind direction, to estimate pollutant concentrations in ambient air. This model accounted for emissions from large industrial facilities, such as power plants and manufacturing facilities, and smaller facilities, such as dry cleaners and gas stations. EPA included emissions from mobile sources such as motor vehicles, trains, planes/airports, ports and boats, and emissions from farming and construction equipment in the modeling estimates. EPA also accounted for secondary formation of pollutants through photochemical mechanisms and pollution due to residential wood burning, wildfires, agricultural burning, and structural fires.

For this evaluation, DOH researchers evaluated HAPs from the 2011 and 2014 NATA. Moving forward, DOH researchers could apply the same approach to earlier versions of NATA. However, it should be noted that earlier versions of NATA do not have the same data quality as the 2011 and 2014 versions. First, HAPs that are considered known or likely human carcinogens based on authoritative review from agencies such as the International Agency for Research on Cancer, EPA's Integrated Risk Information System and US Department of Health and Human Services' National Toxicology Program, were selected for consideration. Next, HAPs for which the NATA cancer risk estimate was above the theoretical (probability-based) cancer risk level of "one excess cancer case in a population of one-million" or "one-in-one-million," were selected for consideration. Because many of the pollutants evaluated in NATA have low modeled concentrations and small cancer risks, the list of HAPs for consideration was reduced to five: 1,3-butadiene, acetaldehyde, benzene, carbon tetrachloride and formaldehyde. The technical support documents for the 2011 and 2014 NATA can be found on-line at: https://www.epa.gov/sites/production/files/2015-12/documents/2011-nata-tsd.pdf, and https://www.epa.gov/sites/production/files/2018-09/documents/2014_nata_technical_support_document.pdf.

Sources of Data for Radon Evaluation

Background

Radon is present everywhere, but some areas are at a higher risk due to their underlying geology. According to the aero-radioactivity maps produced by US Geological Survey (USGS), certain regions in NYS, including the Reading Prong and the Inner Gulf Coastal Plain, showed high levels of uranium and radon decay products. Although these areas stretch over a few counties in NYS, the high radon levels in several adjacent counties could be a result of the radioactivity resulting from the uranium-rich geological structures. Measurements of radon in NYS homes made since 1985 have identified many areas with elevated indoor radon levels. Forty-one of the sixty-two NYS counties show average indoor basement-level radon concentrations greater than 4 picocuries per liter of air (pCi/L) and are considered as “high-risk” radon counties.

Radon in homes is the largest source of radiation exposure to the general public. Most inhaled radon is rapidly exhaled, but the decay products can deposit in the lung. These radioactive particles can cause damage to cells lining the airways, increasing the risk of lung cancer. Homes with high radon concentrations increase their occupants’ risk of developing lung cancer. According to the EPA, radon is the second leading cause of lung cancer following smoking, and the leading cause of lung cancer among non-smokers. Exposure to radon among tobacco smokers greatly increases the risk of lung cancer more than exposure to either radon or smoking alone. Radon is responsible for about 21,000 lung cancer deaths every year, about 2,900 of which occur among people who have never smoked.

There are currently no laws in NYS that require residential radon testing or mitigation of elevated radon levels. The only way to determine radon levels in a home is to test. Although the potential for a home to have an elevated radon level can be estimated, testing is the only way to know for sure. Radon tests can be short-term tests (less than 90 days, typically 2 to 7 days) or long-term tests (3 to 12 months). Short-term tests are useful for screening and for situations where results are needed quickly. The charcoal canister (CC) is the most commonly used device for short-term radon measurements in homes. The device contains activated charcoal that adsorbs radon in air, and the decay products can then be measured by a laboratory. Another type of short-term test is the continuous electronic radon monitor, which generally produces more precise radon measurements and is more tamper resistant than charcoal canisters. Radon levels have been found to change during the day. Levels can also vary due to temperature changes and season and are generally higher in the winter. Long-term tests are therefore considered a better indicator of indoor radon levels as they can provide a true annual average. A commonly used long-term detector is the Alpha Track (AT) detector. When the radon level in the lowest primary living area of the home is above EPA’s action level of 4 picocuries per liter of air (pCi/L), the DOH recommends that the homeowner take appropriate corrective action.

Radon in Indoor Air Monitoring Data

The Radon Program at the DOH Bureau of Environmental Radiation Protection provides short-term testing kits and results to New York State residents to inform them about radon levels in their homes. The results are entered in the program database and are currently available as maps and tables by county starting in 1987 (https://www.health.data.ny.gov/Health/Radon-Test-Results-By-County-Beginning-1987/8e6u-9695). It is important to note that the database is not a comprehensive record of all tests conducted in NYS and only includes tests requested through the DOH Radon program and outreach efforts by the DOH.

For this evaluation, the DOH aimed to characterize radon test results from 1987 to 2015. Researchers used radon data from tests conducted during this period (excluding tests performed at schools and day care centers), to estimate various measures for the Warren County study area and comparison areas including NYS, and NYS excluding NYC. The summary measures of radon test results evaluated for each study and comparison area include total number of tests conducted, average and maximum test values and percent of tests that were at or above the action level of 4 pCi/L. We also determined the number of tests and average radon values by floor level (basement and first floor) in each of the areas. DOH staff also prepared a map for the Warren County study area to display average radon levels by census block group.

Resources for Radon

- NYS Cancer Registry and Cancer Statistics
  https://www.health.ny.gov/statistics/cancer/registry/
- Cancers and Their Risk Factors
  https://www.health.ny.gov/statistics/cancer/registry/abouts/
- Environmental Facilities and Cancer Mapping
  https://apps.health.ny.gov/statistics/cancer/environmental_facilities/mapping/map/
- Radiological Health/Radon
  https://www.health.ny.gov/environmental/radiological/radon/
- A Citizen's Guide to Radon: The Guide to Protecting Yourself and Your Family from Radon
  https://www.epa.gov/radon/citizens-guide-radon-guide-protecting-yourself-and-your-family-radon
- EPA's "Consumer's Guide to Radon Reduction"
  https://www.epa.gov/sites/production/files/2016-12/documents/2016_consumers_guide_to_radon_reduction.pdf
- EPA "Building Radon out"
  https://www.epa.gov/sites/production/files/2014-08/documents/buildradonout.pdf

Sources of Data for Drinking Water Evaluation

Background

A public water system is an entity that provides water to the public for human consumption through pipes or other constructed conveyances. In New York, any system with at least five service connections or that regularly serves an average of at least 25 people daily for at least 60 days out of the year is considered a public water system. Public water systems are categorized as one of the following types of systems: community and non-community (including non-transient non-community and transient non-community). For this assessment, community and non-transient, non-community water sources were examined. A community water system is a public water system that serves the same people year-round. Most residences, including homes, apartments, and condominiums, in cities, towns, and mobile home parks are served by community water systems. Examples of community water systems include municipally-owned (cities, towns, or villages) public water supplies, public water authorities, or privately-owned water suppliers such as homeowner associations, apartment complexes, and mobile home parks that maintain their own drinking water system. A non-transient non-community water system is a water system that serves the same people more than six months per year, but not year-round. Schools, colleges, hospitals and factories with their own water supplies are examples of non-transient non-community water systems. Community and non-transient non-community water resources relate to prolonged daily use of that water, and as such will have greater exposure to analytes if present.

Drinking Water Standards

New York State and the federal government regulate public drinking water systems to protect public health. Regulations have evolved over time for a variety of principal organic compounds (POCs), metals, pesticides, pathogens, and other contaminants. In 1974, Congress passed the Safe Drinking Water Act that standardized the protection of drinking water on a national level. States that previously had established drinking water standards were required to make their standards at least as stringent as the national standards promulgated by the EPA. These national drinking water standards first went into effect in 1977.

Violations of these regulations occur when federally (EPA) established Maximum Contaminant Levels (MCLs) are surpassed. In certain cases, MCLs refer to a running average of samples over a quarterly time frame, meaning an individual exceedance of an MCL may not warrant a violation. Rather, an exceedance occurring over a certain time frame that reaches a mean value above that of the Maximum Contaminant Level would trigger a violation.

Data Sources

DOH researchers evaluated three data sources to assess historical chemical contamination of public drinking water in the Warren County study area. These analytical datasets, though providing some of the best proxies for exposure in study areas, have been collected for a

variety of purposes, including regulatory, compliance, and targeted responses to specific needs to address contamination issues. These data sources are described as follows:

(1) Safe Drinking Water Information System (1999-2018)

The Safe Drinking Water Information System (SDWIS) is a data system developed by EPA to store information about public water systems and their violations of the EPA's drinking water regulations, with the main purpose of keeping public water systems in compliance. These guidelines establish maximum contaminant levels, treatment techniques, and monitoring and reporting requirements that ensure water systems provide safe water to their customers. Data management plays a critical role in helping states and the EPA protect public health. States supervise the public water systems within their jurisdictions to ensure that each system meets state and EPA standards for safe drinking water. New York State currently uses SDWIS as the primary repository for all public water system data. The Safe Drinking Water Act requires states to report drinking water information periodically to the EPA. The 1999-2018 SDWIS data was a primary source for the sampling and contaminant data used in this study.

What information is included in the SDWIS Database?

- Basic information about each public water system, including:
  - ✓ the system's name
  - ✓ ID number
  - ✓ city or county served
  - ✓ number of people served
  - ✓ type of system (community, non-transient non-community, etc.)
  - ✓ whether the system operates year-round or seasonally
  - ✓ characteristics of the system's source(s) of water (ground water, surface water, etc.)
- Violation information for each public water system, including whether the system has:
  - ✓ failed to follow established monitoring and reporting schedules
  - ✓ failed to comply with mandated treatment techniques
  - ✓ violated any Maximum Contaminant Levels (MCLs)
  - ✓ failed to communicate required information to their customers
- Enforcement information, including actions the state or EPA have taken to ensure that a public water system returns to compliance if it is in violation of a drinking water regulation.

Tables A-IV-1 to A-IV-7 list a total of 129 analytes in seven categories based on their properties that were examined for the evaluation of potential unusual exposures via public drinking water systems.

Table A-IV-1 List of Principal Organic Compounds (POCs)

No	Name	No	Name
1	1,1-DICHLOROETHANE	29	DICHLOROMETHANE
2	1,1-DICHLOROETHYLENE	30	ETHYLBENZENE
3	1,1-DICHLOROPROPENE	31	HEXACHLOROBUTADIENE
4	1,1,1-TRICHLOROETHANE	32	ISOPROPYLBENZENE
5	1,1,1,2-TETRACHLOROETHANE	33	M-DICHLOROBENZENE
6	1,1,2-TRICHLOROETHANE	34	META-XYLENE
7	1,1,2,2-TETRACHLOROETHANE	35	METHYL TERT-BUTYL ETHER
8	1,2-DICHLOROETHANE	36	N-BUTYLBENZENE
9	1,2-DICHLOROPROPANE	37	N-PROPYLBENZENE
10	1,2,3-TRICHLOROBENZENE	38	O-CHLOROTOLUENE
11	1,2,3-TRICHLOROPROPANE	39	O-DICHLOROBENZENE
12	1,2,4-TRICHLOROBENZENE	40	ORTHO-XYLENE
13	1,2,4-TRIMETHYLBENZENE	41	P-CHLOROTOLUENE
14	1,3-DICHLOROPROPANE	42	P-DICHLOROBENZENE
15	1,3,5-TRIMETHYLBENZENE	43	P-ISOPROPYLTOLUENE
16	2,2-DICHLOROPROPANE	44	PARA-XYLENE
17	BENZENE	45	SEC-BUTYLBENZENE
18	BROMOBENZENE	46	STYRENE
19	BROMOCHLOROMETHANE	47	TERT-BUTYLBENZENE
20	BROMOMETHANE	48	TETRACHLOROETHYLENE
21	CARBON TETRACHLORIDE	49	TOLUENE
22	CHLOROBENZENE	50	TRANS-1,2-DICHLOROETHYLENE
23	CHLOROETHANE	51	TRANS-1,3-DICHLOROPROPENE
24	CHLOROMETHANE	52	TRICHLOROETHYLENE
25	CIS-1,2-DICHLOROETHYLENE	53	TRICHLOROFLUOROMETHANE
26	CIS-1,3-DICHLOROPROPENE	54	VINYL CHLORIDE
27	DIBROMOMETHANE	55	XYLENE, META AND PARA
28	DICHLORODIFLUOROMETHANE	56	XYLENES, TOTAL

Table A-IV-2 List of Nitrates (NITs)

No	Name
1	NITRATE
2	NITRATE-NITRITE
3	NITRITE

Table A-IV-3 List of Primary Inorganic Compounds (PICs)

No	Name
1	ANTIMONY, TOTAL
2	ARSENIC
3	BARIUM
4	BERYLLIUM, TOTAL
5	CADMIUM
6	CHLORIDE
7	CHROMIUM
8	COLOR
9	CYANIDE
10	FLUORIDE
11	IRON
12	MANGANESE
13	MERCURY
14	NICKEL
15	ODOR
16	SELENIUM
17	SILVER
18	SULFATE
19	THALLIUM, TOTAL
20	ZINC

Table A-IV-4 List of Synthetic Organic Compounds (SOCs)

No	Name	No	Name
1	2,3,7,8-TCDD	21	DINOSEB
2	2,4-D	22	ENDRIN
3	2,4,5-TP	23	ETHYLENE DIBROMIDE
4	3-HYDROXYCARBOFURAN	24	HEPTACHLOR
5	ALDICARB	25	HEPTACHLOR EPOXIDE
6	ALDICARB SULFONE	26	HEXACHLOROBENZENE
7	ALDICARB SULFOXIDE	27	HEXACHLOROCYCLOPENTADIENE
8	ALDRIN	28	LASSO
9	ATRAZINE	29	METHOMYL
10	BENZO(A)PYRENE	30	METHOXYCHLOR
11	BHC-GAMMA	31	METOLACHLOR
12	BUTACHLOR	32	METRIBUZIN
13	CARBARYL	33	OXAMYL
14	CARBOFURAN	34	PENTACHLOROPHENOL
15	CHLORDANE	35	PICLORAM
16	DALAPON	36	PROPACHLOR
17	DI(2-ETHYLHEXYL) ADIPATE	37	SIMAZINE
18	DI(2-ETHYLHEXYL) PHTHALATE	38	TOTAL POLYCHLORINATED BIPHENYLS (PCB)
19	DICAMBA		
20	DIELDRIN	39	TOXAPHENE

Table A-IV-5 List of Radiological Samples (RADs)

No	Name
1	COMBINED RADIUM (-226 & -228)
2	GROSS ALPHA PARTICLE ACTIVITY
3	GROSS BETA PARTICLE ACTIVITY
4	RADIUM-226
5	RADIUM-228
6	THORIUM
7	URANIUM

Table A-IV-6 List of Disinfection By-products (DBPs)

No	Name
1	TOTAL HALOACETIC ACIDS (HAA5)
2	TOTAL TRIHALOMETHANES (TTHM)

Table A-IV-7 List of Lead and Copper (PBCU)

No	Name
1	COPPER
2	LEAD

For this analysis, an analyte is considered in exceedance if the measured level is above the relevant EPA-developed Maximum Contaminant Level (MCL) and Action Level, as well as NYS-developed Action Levels. The same contaminant parameters were applied to all four study areas in the Governor's Cancer Research Initiative project, and all exceedances were analyzed. In certain circumstances, exceedances may not warrant a violation until a quarterly average exceeds EPA or NYS levels. Previous studies have found associations between certain analytes and certain cancer types. However, the exposures being measured in these studies generally occur over a long period of time and at much higher analyte concentrations than those that are measured in drinking water systems.[1]

Table A-IV-8 List of 30 Contaminants in the 3rd Unregulated Contaminant Monitoring Rule

Group	Contaminant	Method Name
Chemical	1,2,3-trichloropropane	Volatile Organic Compounds
	1,3-butadiene	Volatile Organic Compounds
	methyl chloride	Volatile Organic Compounds
	1,1-dichloroethane	Volatile Organic Compounds
	methyl bromide	Volatile Organic Compounds
	chlorodifluoromethane (HCFC-22)	Volatile Organic Compounds
	bromochloromethane (Halon 1011)	Volatile Organic Compounds
	1,4-dioxane	Synthetic Organic Compound
	vanadium	Metals
	molybdenum	Metals
	cobalt	Metals
	strontium	Metals
	total chromium	Metals
	chromium-6	Chromium-6
	chlorate	Oxyhalide Anion
	perfluorooctanesulfonic acid (PFOS)	Perfluorinated Compounds
	perfluorooctanoic acid (PFOA)	Perfluorinated Compounds
	perfluorononanoic acid (PFNA)	Perfluorinated Compounds
	perfluorohexanesulfonic acid (PFHxS)	Perfluorinated Compounds
	perfluoroheptanoic acid (PFHpA)	Perfluorinated Compounds
	perfluorobutanesulfonic acid (PFBS)	Perfluorinated Compounds
	17β-estradiol	Hormones
	17α-ethynylestradiol (ethinyl estradiol)	Hormones
	16-α-hydroxyestradiol (estriol)	Hormones
	equilin	Hormones
	estrone	Hormones
	testosterone	Hormones
	4-androstene-3,17-dione	Hormones
Virus	enteroviruses	Enterovirus cell culture / RT-qPCR
	noroviruses	Norovirus genogroup I with RT-qPCR primer set A/B

(2) Unregulated Contaminant Monitoring Rule 3 (2013-2015) Occurrence Data

2013-2015 Occurrence Data for unregulated contaminants is provided through the 3rd Unregulated Contaminant Monitoring Rule (UCMR 3), which was published by the EPA on May 2, 2012.[2] The UCMR 3 required monitoring for 30 contaminants (i.e., 28 chemicals and two viruses) in drinking water for all systems serving a population over 10,000 and a few selected systems with populations under this limit. Table A-IV-8 lists the 30 contaminants in the UCMR 3. Unregulated contaminant occurrence data is gathered by observing public water systems for contaminants, providing the EPA and other interested parties with nationally representative data on the occurrence of contaminants in drinking water. Additionally, this dataset shows the number of people potentially being exposed and an estimate of that exposure. This information provides the basis for future regulatory actions to protect public health.

(3) Spatially-referenced Datasets

In addition to the datasets that were listed above, spatial data was also used as part of this evaluation. These data sources were used to delineate public water service areas and to provide specific well locations and associated sample data. Water district and pressure zone boundaries were developed by DOH researchers based on water distribution records.

Sources of Data for Industrial and Inactive Hazardous Waste Disposal Sites

DEC and DOH each have a role in managing contaminated sites and preventing and/or minimizing human exposures to site-related contaminants. The mission of the DEC's Division of Environmental Remediation is to protect public health and the environment of the State of New York by: preventing releases to the environment through the regulation of petroleum and chemical bulk storage facilities, hazardous waste facilities, and radiation facilities; and responding to, investigating, and remediating releases of contaminants that have occurred. DOH staff work with DEC staff to investigate the potential for human exposure to site-related environmental contamination, primarily at inactive hazardous waste sites and brownfield sites. For every state, federal superfund, brownfield, and voluntary clean-up site, a specialist is assigned to coordinate and communicate health-related activities. In addition, DOH staff prepare public health assessments for federal superfund sites under an agreement with the federal Agency for Toxic Substances and Disease Registry. Staff also conduct exposure investigations as part of the state's Cancer Surveillance Improvement Initiative.

Sources of Data for Traffic Evaluation

The New York State Department of Transportation (DOT) operates a Traffic Monitoring Program which collects information on traffic counts at fixed and temporary monitoring locations. This information is processed to create average annual daily traffic (AADT) counts for road segments along interstate highways and all NYS routes and roads that are part of the Federal Aid System. Computer software is used to link datasets with AADT with road segment

locations. DOH researchers reviewed information from DOT's program and used this data to assess how traffic in the study area compares to traffic in other areas of NYS.

References for Appendix IV

1. National Cancer Institute. *Drinking Water Contaminants*. Accessed on December 12, 2018; Available from: https://dceg.cancer.gov/research/what-we-study/drinking-water-contaminants.
2. EPA (United States Environmental Protection Agency). 2017. *The Third Unregulated Contaminant Monitoring Rule (UCMR 3): Data Summary, January 2017*. Cited on May 4, 2019; Available from: https://www.epa.gov/sites/production/files/2017-02/documents/ucmr3-data-summary-january-2017.pdf.

Appendix V – Toxicological Information for NATA Primary Air Toxic Risk Drivers in Warren County

(A) 1,3-Butadiene

According to the Toxicological Profile for 1,3-butadiene published by the Agency for Toxic Substances and Disease Registry (ATSDR), 1,3-butadiene is released from industrial sources, automobile exhaust, cigarette smoke and the burning of wood and rubber/plastic (ATSDR, 2012).

The EPA, National Toxicology Program (NTP) and International Agency for Research on Cancer (IARC) classify this chemical as carcinogenic to humans. This classification is based on sufficient evidence from epidemiologic studies of workers exposed to 1,3-butadiene that show an increased incidence of cancers of the blood and lymphatic system, but exposure information for these studies is lacking (ATSDR, 2012). Animal studies provide additional evidence of carcinogenicity. 1,3-Butadiene is associated with several non-cancer effects as well.

(B) Acetaldehyde

People are exposed to small amounts of acetaldehyde each day. Acetaldehyde is used in the chemical manufacturing industry and in numerous consumer products, including perfumes. It is found in tobacco, wood smoke and vehicle exhaust. It is also used as a flavoring agent, as allowed by the Food and Drug Administration and is found in trace amounts in many plant products that people eat (NTP, 1991). According to the National Toxicology Program (NTP), most people's exposure to acetaldehyde is through the consumption of alcoholic beverages.

The NTP states that acetaldehyde is reasonably anticipated to be a human carcinogen based on sufficient evidence in animal studies. Similarly, EPA classifies acetaldehyde as a probable human carcinogen based on sufficient evidence in animals (EPA, 1998). Whether or not acetaldehyde causes cancer in humans is unknown. Animal studies have identified increased incidence of nasal and laryngeal tumors caused by long-term inhalation of high concentrations of acetaldehyde.

(C) Benzene

Benzene is widely used in the US and ranks in the top 20 chemicals for US production volume, according to the ATSDR's Toxicological Profile (ATSDR, 2007). ATSDR reports that the major sources of benzene exposure are tobacco smoke, automobile service stations, exhaust from motor vehicles, and industrial emissions, including petrochemical plants and coke ovens. Benzene is also present in wood smoke. There are also natural sources of benzene. People living in urban environments are exposed to more benzene that those residing in rural areas. Benzene levels indoors are usually higher than outdoors (ATSDR, 2007).

Benzene has been classified as a known human carcinogen by NTP, EPA and IARC. Toxicologists at these agencies conclude that benzene is a human carcinogen is based on sufficient inhalation data in humans that is also supported by animal evidence. According to the ATSDR, the human cancer caused by inhalation exposure to benzene is predominantly leukemia, especially acute nonlymphocytic (myelocytic) leukemia, whereas benzene exposure in animal studies causes multiple cancer sites by both the inhalation and oral routes of exposure. Long-term inhalation of high levels of benzene can also cause hematological, immunological and neurological effects.

(D) Carbon Tetrachloride

Carbon tetrachloride is an industrial chemical that doesn't occur naturally. According to the ATSDR, it was used primarily as a refrigerant and aerosol propellant but also as a pesticide, degreaser, cleaning agent, in fire extinguishers and as a spot remover. Because of its ozone-depleting potential, manufacture and use of carbon tetrachloride was banned (phased-out) with the Montreal Protocol (adopted in 1987). Because the chemical is very stable, it stays in the air for long periods of time without breaking down. Carbon tetrachloride is found in outdoor and indoor air (ATSDR, 2005).

Occupational studies of carbon tetrachloride indicate that human exposure to high levels of this chemical can cause neurological effects (e.g., intoxication, dizziness, headache, sleepiness) and can damage the liver and kidney (ATSDR, 2007). High levels of exposure to carbon tetrachloride in air causes an increased incidence of liver tumors in animal studies (ATSDR, 2007). As such, the EPA, IARC and NTP have classified this chemical as "likely to be carcinogenic," "possibly carcinogenic," and "reasonably anticipated to be a human carcinogen," respectively. Whether or not carbon tetrachloride causes cancer in humans is unknown.

(E) Formaldehyde

According to the ATSDR, everyone is exposed to small amounts of formaldehyde in air and in some foods and consumer products (ATSDR, 1999). The main source of formaldehyde in the atmosphere is believed to be from photo-oxidation of hydrocarbon combustion products, and studies have demonstrated that daily variations in outdoor formaldehyde concentrations correlate with traffic conditions (ATSDR, 1999; ATSDR, 2010). Formaldehyde is also present in wood smoke.

Formaldehyde irritates the eyes, throat and respiratory system and also can cause neurological effects if people are exposed to sufficient amounts. An increased incidence of respiratory tract tumors, including squamous cell tumors, is seen in animals exposed to high levels of formaldehyde. As such, the EPA classifies formaldehyde as a probable human carcinogen; the NTP reasonably anticipates the chemical to be a human carcinogen; and, IARC classifies formaldehyde as a human carcinogen. Whether or not formaldehyde causes cancer in humans is unknown.

According to ATSDR, urban air contains more formaldehyde than rural areas; summertime outdoor air concentrations are higher than wintertime; and indoor air often contains higher amounts of formaldehyde than outdoor air (ATSDR, 1999; ATSDR, 2010).

References for Appendix V

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