DEPARTMENT OF HEALTH

Brief Update on Cancer Occurrence in East Metro Communities

February, 2018

Brief Update on Cancer Occurrence in East Metro Communities

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Findings

In response to community concerns arising from media coverage of the State of Minnesota lawsuit against 3M, The Minnesota Department of Health (MDH) has re-examined and expanded on two previous reports of cancer incidence in Washington and Dakota Counties, and eight communities within those counties.

Based on 25 years of data, the overall cancer rate in Washington County is virtually identical to the statewide average. As previously reported, cancer rates in Washington County are comparable to statewide rates for most specific types of cancer. Several cancers had higher rates (female breast, melanoma, chronic lymphocytic leukemia), while other cancers had lower rates (larynx, lung, oral cavity, small intestine, stomach). Mortality rates for breast cancer, chronic lymphocytic leukemia, and prostate cancer were not elevated in Washington County.

Cancer rates within the eight communities that had some history of water contamination did not differ from other Metro area communities, except for lower rates of oral and pancreatic cancer.

In Oakdale, we found small excesses of total cancers and female breast cancer. For childhood cancers, there were some elevations in both mortality and incidence, although only one of 12 comparisons was statistically significant. There were no statistical differences in the types of childhood cancers in Oakdale compared to the Metro or all Minnesota.

As seen in these communities, rates of specific types of cancer can vary greatly by location and by time frame, and most all counties and communities will have some deviations from the statewide averages.

The findings in this report address observable cancer rates in specific communities; they cannot be used to either identify or refute potential adverse health effects from environmental contaminants.

Background

Recent documentation related to a State of Minnesota lawsuit against 3M contained a number of assertions about cancer incidence and adverse birth outcomes in specific areas of the east Metro. MDH scientists reassessed data from these communities using sound public health procedures widely accepted and used around the country. The assertions specified that “statistically significant” elevations of several cancers were found in Washington County, including:

- Chronic lymphocytic leukemia
- Bladder cancer
- Kidney cancer
- Non-Hodgkin lymphoma
- Prostate cancer
- Breast cancer
- All cancers combined

The case documents also stated that there were elevated rates of death among Oakdale adults and children where the death certificate mentioned cancer or any "pre-cancerous" condition. Other findings included a higher prevalence of premature births and low birth weight births in the affected communities. The birth outcomes are addressed in a separate report.

The purpose of this brief update is to (1) summarize previous department of health analyses of cancer rates in these communities; (2) provide data from additional analyses that were not part of the previous reports; (3) provide additional perspective in interpreting county-level or community-level cancer rates; and (4) provide information about the known risk factors for cancer.

Data Sources

The primary source of cancer data for this report is the Minnesota Cancer Reporting System (MCRS), formerly known as the Minnesota Cancer Surveillance System. MCRS is Minnesota's statewide, population-based cancer registry. MCRS systematically collects demographic, diagnostic and treatment information on all Minnesota residents who have newly diagnosed cancers. The data, collected since 1988, come from hospitals, clinics and pathology laboratories and are carefully reviewed for completeness and accuracy. Independent audits estimate that the completeness of the MCRS data is over 99 percent.

The county of residence at the time of diagnosis is the geographic unit used for describing the incidence of cancer in Minnesota. Analysis of cancer incidence at the ZIP code level is not routine or automated, can require substantial additional staff effort, and may be subject to errors due to uncertainties in the size and characteristics of populations who reside in a ZIP code. These analyses are conducted when the numbers of cancers are sufficiently large to provide statistical reliability and protect privacy, when population data are available, and when the analysis would be useful in addressing the issue or concern. Implementing a new cancer reporting system in 2018 will greatly facilitate geographic analyses of cancer rates.

Other sources of data used in this report include the Centers for Disease Prevention and Control (CDC) Multiple Cause of Death database, The Surveillance, Epidemiology, and End Results (SEER) Program of the National Cancer Institute program of state cancer registries, the United States Census Bureau, and the American Community Survey.

Previous and expanded analyses of east Metro community cancer rates

In response to concerns about cancer and the presence of perfluorochemicals (PFCs) in drinking water supplies in the eastern Metro area communities, the Minnesota Department of Health (MDH) has twice examined cancer incidence – rates of newly diagnosed cancers – among

Dakota County and Washington County residents. This analysis included eight communities within those counties with known or potential contaminated water, including Oakdale.

MCRS staff conducted analyses that resulted in two reports. The first study, published in 2007, included data through 2002. The second study, published in 2015, included slightly revised data

from the previous period as well as more recent data from 2003 to 2012. These reports are available from the Minnesota Department of Health.

This expanded analysis will summarize only the findings from the 2015 report and will focus on rates for Washington County and the eight communities, six in Washington County and two in Dakota County.

County Level Analyses of Cancer Rates

MDH examined some 200 comparisons of cancer incidence rates by county, by gender, by time period, and by type of cancer. The standard methods used for those comparisons are detailed in the 2015 report.

Of those 200 comparisons, 173 showed no differences between the county rate and the statewide rate. County rates were lower than statewide rates for 15 comparisons and higher than statewide rates for 12 comparisons. However, many of those differences (elevations and deficits) were not consistent over the two time periods or between sexes, and were suggestive of random variation. For Washington County alone, among the 100 comparisons, rates of ten cancers were higher, while rates of seven cancers were lower than statewide rates. Again, there was very little consistency over the two time periods or between sexes.

To obtain a more complete assessment, an additional analysis was conducted combining the Washington County data from both time periods and both sexes. Based on the 1988 to 2012 data, there were small but statistically significant elevations of female breast cancer (7%) and melanoma of the skin (13%) compared to statewide rates. Statistically lower rates of cancers of the larynx, lung, oral cavity, small intestine, and stomach appeared when compared to the statewide average. No differences were found for rates of total cancers, prostate cancer, bladder cancer, non-Hodgkin lymphoma, or kidney cancer (Figure 1).

For the two Washington County elevated cancers (female breast cancer and melanoma), we conducted several additional analyses. For breast cancer, an analysis of mortality rates covered the period 1999 to 2016. In contrast to the elevated incidence of female breast cancer, the female breast cancer mortality rate in Washington County (21.2/100,000) was virtually identical to the statewide rate (21.1) and the Metro rate (21.5). Data examined also included the stage at diagnosis for breast cancer cases identified during 1999 to 2013. While there were no differences in stage distribution between Washington County and Minnesota for non-Hispanic white women (Figure 2), there was a higher proportion of early stage diagnoses among women of other races in Washington County compared to Minnesota (Figure 3). The melanoma mortality rate in Washington County (2.8/100,000) was slightly higher than the statewide rate (2.4), similar to the elevation in the incidence rate.

Although the prostate cancer incidence rate was not elevated, we also examined mortality rates for this cancer. The Washington County rate (22.6) was comparable to the statewide rate (24.3) for the period 1999 to 2016.

Since the 2015 report didn't examine specific types of leukemia, we conducted a new analysis of incidence rates for chronic lymphocytic leukemia (CLL) for 1999 to 2013 compared to several other counties and to Minnesota overall. Over this time period, a 28% elevation in the rate of this cancer was found in Washington County among both males and females compared to the

statewide rate (Figure 4). In contrast, the mortality rate for CLL in Washington County for the period 1999 to 2016 (1.82/100,000) was virtually identical to the Metro rate (1.82) as well as the statewide rate (1.83). As shown in Figure 5, over an expanded time period 1988 to 2014, incidence rates of CLL in Washington County vary greatly from year to year, fluctuating both above and below the statewide rate. For the whole period of available data, the incidence rate in Washington County was about 16% higher than the statewide rate. Figures 6 and 7 provide an indication of the variability in CLL rates at the county-level for all Minnesota.

Community cancer rates for Washington and Dakota Counties

The 2015 report also examined cancer rates for eight communities (based on ZIP codes) with known or potential water contamination in public or private wells. Two time periods were analyzed by sex, 1996 to 2004 and 2005 to 2012. We compared these rates to the seven-county Metro region. Due to the small numbers, cancer rates at the community level are highly unstable and difficult to interpret, particularly when analyzed separately by gender and specific types of cancer. Further limitations on the analysis and interpretation of ZIP code level cancer data are outlined in the 2015 report. These communities and their ZIP codes are listed below:

Zip Code	City	County
55016	Cottage Grove	Washington
55033	Hastings	Dakota
55042	Lake Elmo	Washington
55055	Newport	Washington
55071	St Paul Park	Washington
55075	South St. Paul	Dakota
55128	Oakdale	Washington
55125,55129	Woodbury	Washington

For this updated analysis to reduce the variability, data for the two time periods and two sexes were combined. For the eight communities combined, there were no statistical differences in cancer incidence compared to the Metro for the 17 cancer categories analyzed, except for the lower rate of cancers of the oral cavity and pancreas (Figure 8).

For Oakdale, two of the 17 cancer categories were statistically elevated: a 12% elevation of female breast cancer (similar to the county-wide elevation); and an 8% elevation in total cancers (Figure 9). The lung cancer rate was also marginally elevated (13%).

As previously noted, community cancer rates must be interpreted very cautiously. Rates are unstable over time, and potential errors can occur both in case identification and in detailed population data estimates in non-census years needed for determining rates. Furthermore, cancer surveillance data on significant risk factors including smoking and obesity are not available.

Childhood Cancer Rates

The 2015 report included data on cancer rates among children (0 to 19 years of age) for the county-level analyses for two periods, 1988 to 2002 and 2003 to 2012. Childhood cancer rates in that report were not different from statewide rates for either county, for either time period, for either sex. As shown in Figure 1, in the combined data for Washington County (both time periods and sexes combined), the rate of childhood cancer (all types) in Washington County for 1988 to 2012 was comparable to the statewide rate. That was also the case for Dakota County (data not shown).

MDH did not analyze childhood cancer rates in the 2015 report for the eight communities due to the extremely small numbers of cases. There are on average about 10 cases per year in all of Washington County. However, we conducted further analyses in this update due to the assertions in the lawsuit of a “171 percent” elevation of childhood deaths (0 to 19 years) in Oakdale where there was any mention of cancer or a “cancer-related” condition on the death certificate compared to a control area.

To evaluate childhood cancer occurrence among Oakdale residents, we conducted analyses of both childhood cancer incidence and mortality for two age groups commonly used in cancer surveillance programs: 0 to 14 years of age and 0 to 19 years of age. The rates and frequencies of specific cancers varies between those two age ranges. We also used several comparison populations.

For deaths, we examined mortality data for children for both age groups in Oakdale and Washington County where there was any mention of a tumor or pre-cancerous condition on the death certificate (ICD-10 codes C00-D48) for the period 1999 to 2016. There are only about two such deaths per year in all of Washington County. The analysis identified two deaths among the 0 to 14 age category and seven deaths among the 0 to 19 category. As shown in the lower portion of Figure 10, the number of deaths in the 0 to 14 category was less than expected, while the number of deaths in the 0 to 19 was higher than expected regardless of the comparison population. None of the differences, however, were statistically significant due to the very small numbers involved.

For cancer incidence, we again examined the two age groupings, but also included two time periods: 1999 to 2014 and 1988 to 2014. These findings are also shown in Figure 10. For the 1999 to 2014 period, there were 20 cases among children aged 0 to 14 years and 35 cases among those aged 0 to 19. For the full 1988 to 2014 period, there were 28 cases among 0 to 14 year olds, and 43 cases among 0 to 19 year olds. Among the 12 rate comparisons, the only rate

that was statistically elevated (a 56% excess) was among 0 to 19 year olds during the period 1999 to 2014 when compared to the statewide rate. Again, the rate comparisons were based on relatively small numbers.

As with adult cancers, childhood cancers represent a number of very different diseases with different risk factors. Consequently, we further examined the distributions of the major types of childhood cancer among Oakdale residents to determine whether a single type of childhood cancer was disproportionately more common. These findings are shown in Figure 11 for the 0 to 14 age category and in Figure 12 for the 0 to 19 age category. Using the most complete data (0 to 19; 1988 to 2014), statistical testing indicated that there were no statistically significant differences in the distribution of cancer types when Oakdale was compared to either the Metro area or to all Minnesota distributions.

Usefulness and Limitations of Community Cancer Rates in Addressing Environmental Cancer Concerns

The MCRS is a vital tool for examining cancer rates and trends in Minnesota, and MCRS data are extremely useful in facilitating epidemiologic studies of specific cancers, quality of care studies, evaluating screening and prevention programs, among other purposes.

While community cancer rates have a high degree of statistical uncertainty and must be interpreted cautiously, such data are also very useful in addressing public concerns over cancer rates in a county or a community by providing a more complete and accurate profile of cancer occurrence. However, for many reasons, analyses of community cancer rates are rarely useful in documenting potential cancer risks from low levels of environmental pollutants.

- Cancer is not a single disease but a group of more than 100 different diseases. Cancers differ in their rates of occurrence, risk factors, treatment, and survivorship. Unfortunately, cancer is not a rare disease, especially when considered in terms of lifetime risk. Not including the most common forms of skin cancer, the average lifetime risk of developing some type of cancer (in situ or malignant) ranged from 48% (2000 to 2002) to 41% (2012 to 2014) among males and 41% among females (National Cancer Institute). On average, almost one in two people will have a diagnosis of cancer during their lifetimes. For any individual, of course, the lifetime risk will be dependent on many personal factors like smoking history, obesity, alcohol use, family history, and many other risk factors.
- The time period for cancer to develop, called the latency period, is typically several decades. Many cancers diagnosed today are due to exposures and lifestyle experiences that began or happened many years ago. Unfortunately, it is often not possible to know when and to what extent newly-identified contaminants would have created the potential for exposure in a community. Furthermore, because people move frequently, many residents in a community may not live there for more than five years prior to their diagnosis of cancer. Thus, community cancer rates are frequently comprised of people who differ in their residential histories in the community, their personal risk factors for cancer, as well as in their potential exposures to environmental contaminants.
- While we have no control over risk factors like age, race, family history, and genetics, much of our cancer risk is strongly influenced by lifestyle factors that we can control. These

lifestyle risk factors include cigarette smoking, obesity, alcohol consumption, ionizing and solar radiation, viruses like hepatitis, occupation, and physical inactivity (Figure 13). Those factors account about 60% of cancer deaths in the United States. Other lifestyle factors that increase risk include reproductive patterns, sexual behavior, and medications, (Colditz and Wei, 2012; Shottenfeld et al, 2013; Islami et al, 2018). However, even when no modifiable risk factors are known that can reduce the risk of developing a cancer, screening and early diagnosis may prevent or reduce the risk of death.

- While little is known about the causes of some types of cancer (e.g., brain tumors), for many types of cancer, specific risk factors have been identified (Figure 14), many of which are potentially modifiable. For some cancers, these known risk factors account for a significant proportion of cancer occurrence. For example, 85 to 90% of lung cancer is attributable to smoking and over 95% of cervical cancer is due to the Human Papilloma Virus (HPV). Known risk factors for cancer in communities and counties can vary widely, contributing to the variability of cancer rates. While age and gender distributions in a community can routinely be accounted for, lack of information about other known determinants of cancer incidence, like smoking histories, in a given population makes it difficult to attribute any observed excess or deficit in cancer rates to a given cause.
- Well-designed epidemiological studies, in addition to toxicological research, are necessary to answer questions about the extent to which an environmental exposure may be contributing to the occurrence of cancers in human populations. Indeed, most known human carcinogens have been identified through epidemiologic studies of occupational groups. Cancer risks are much more likely to be detected in the workplace rather than in a community setting since (1) occupational exposures are generally much greater than community exposures; (2) it is frequently possible to estimate past exposures in a workplace using industrial hygiene data, job histories, and other data; and (3) it is usually possible to identify all the people who worked at a workplace for a particular time period using personnel records.

State and federal regulatory standards and guidelines are intended to limit exposures to potential carcinogens to very low risks, for example, one additional cancer in 100,000 people with lifetime exposure. This level of cancer risk is purposefully many thousands of times lower than cancer risks that can be detected by epidemiologic studies or examination of community cancer rates.

Figures

Figure 1

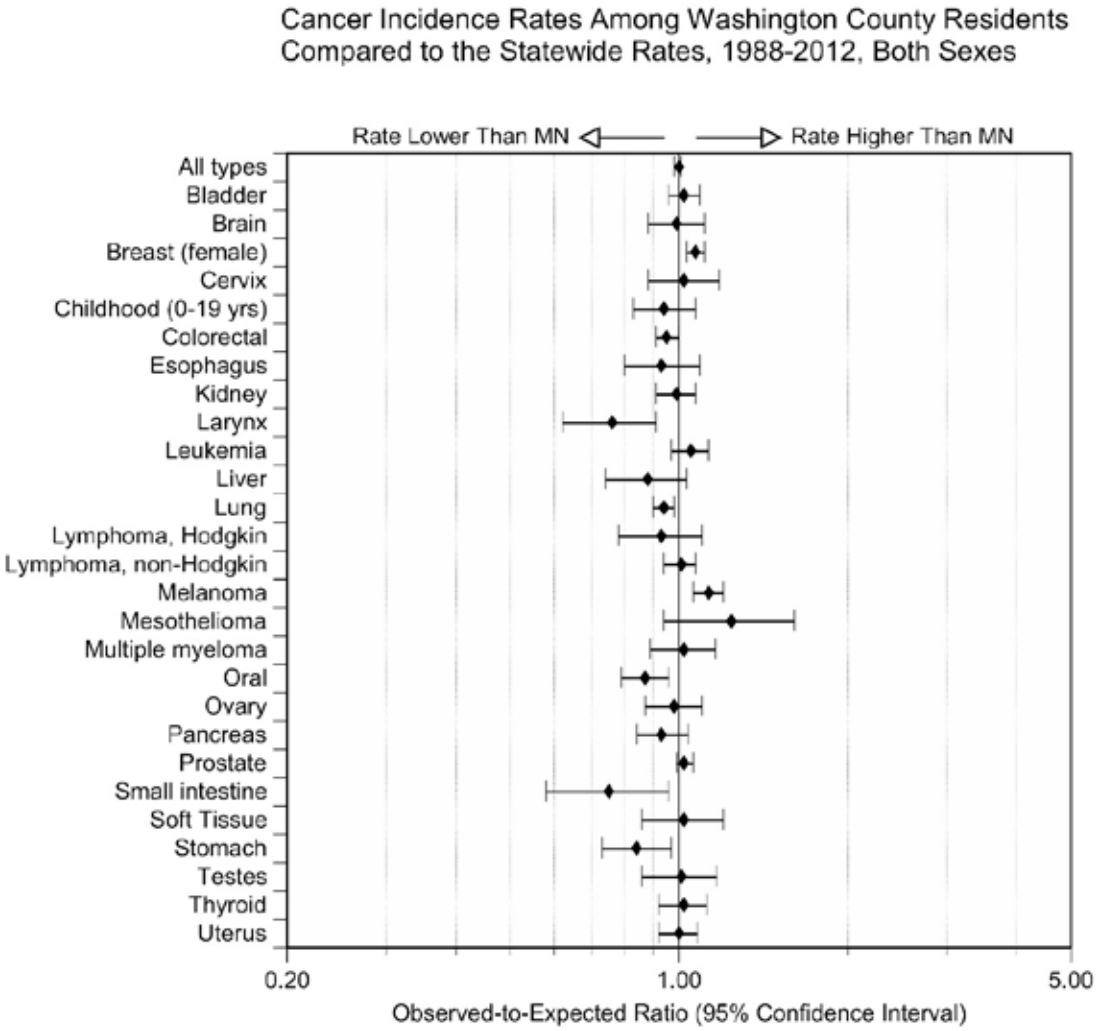


Figure 2

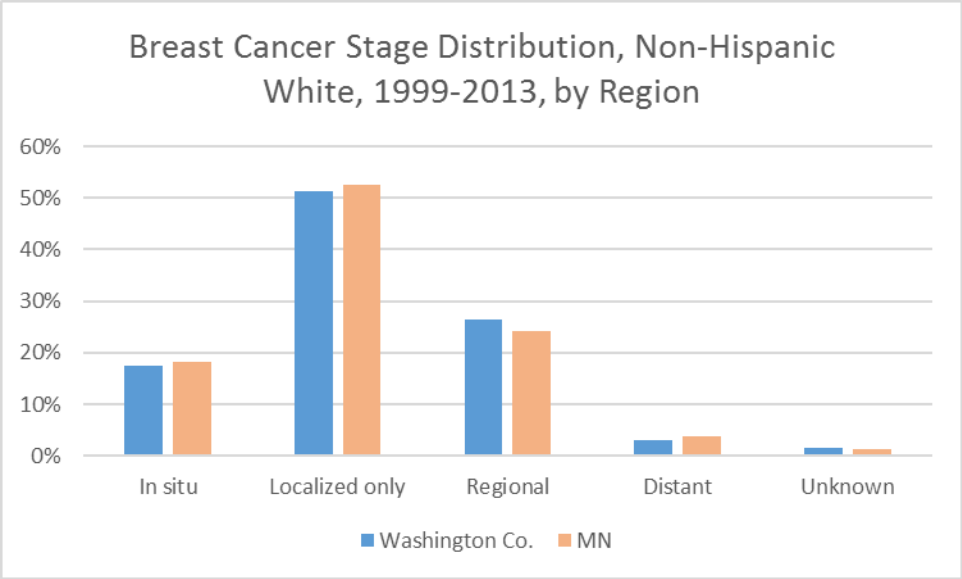


Figure 3

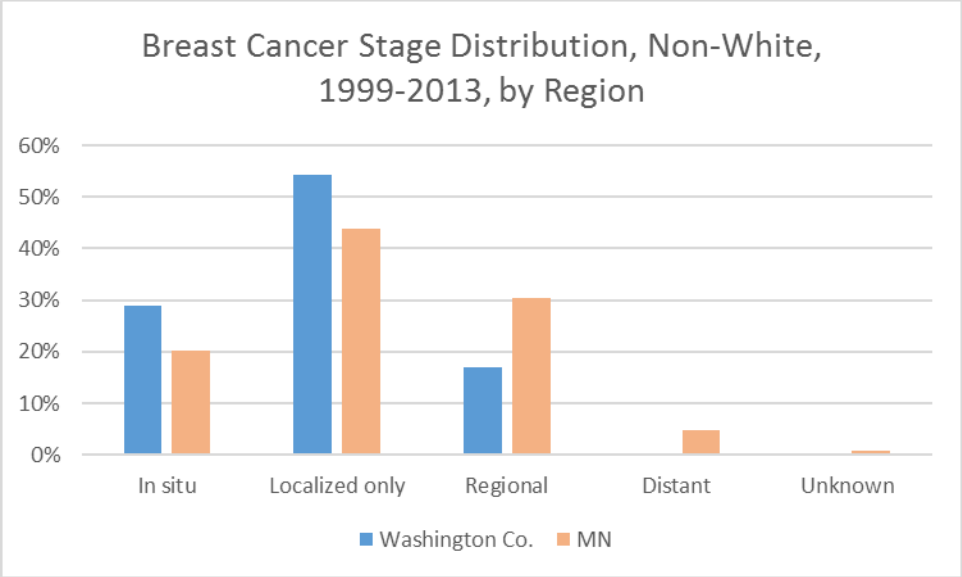


Figure 4

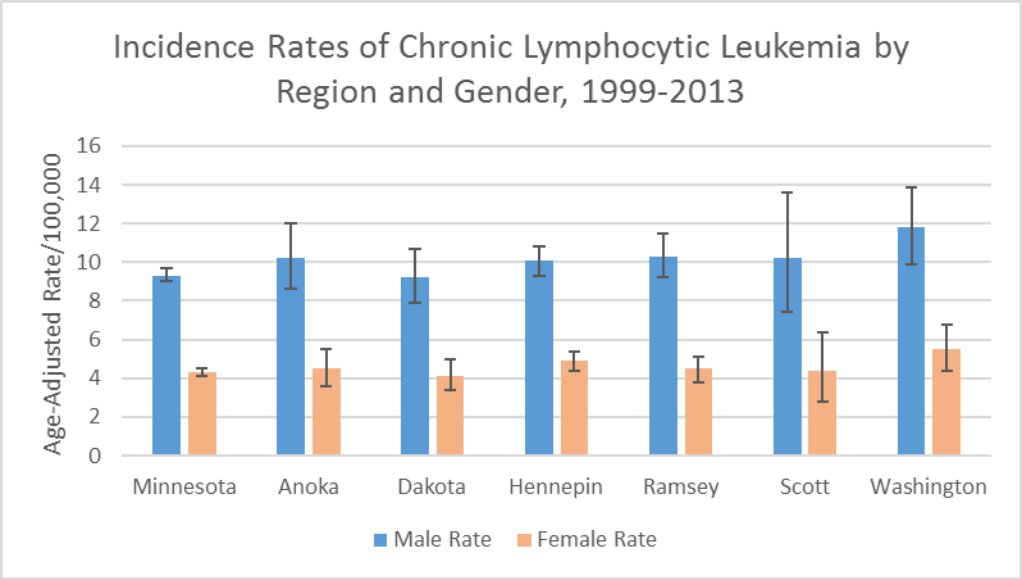


Figure 5

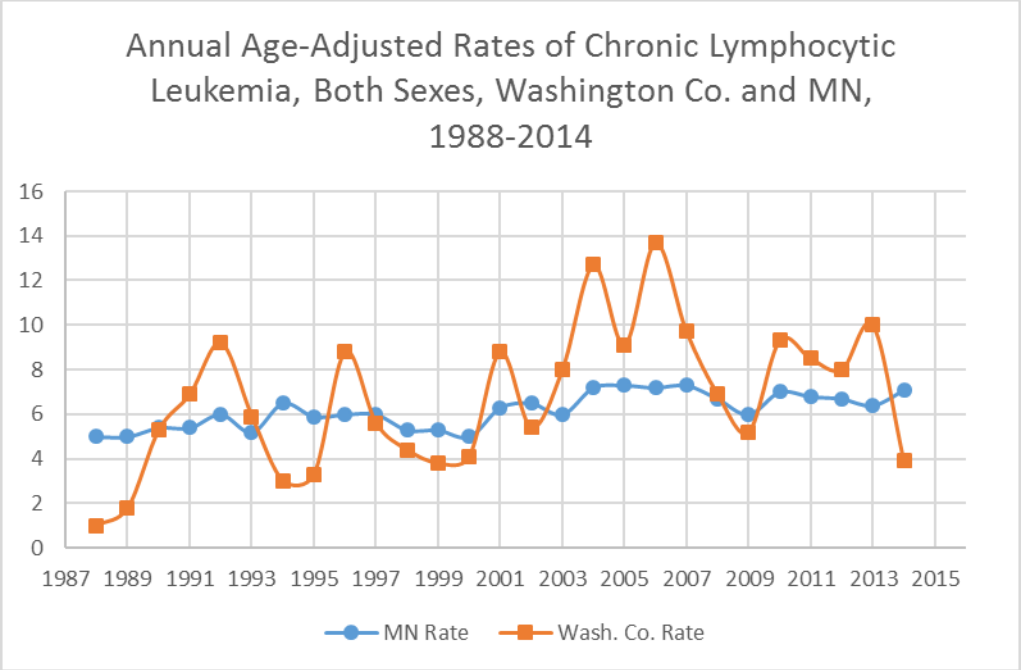


Figure 6

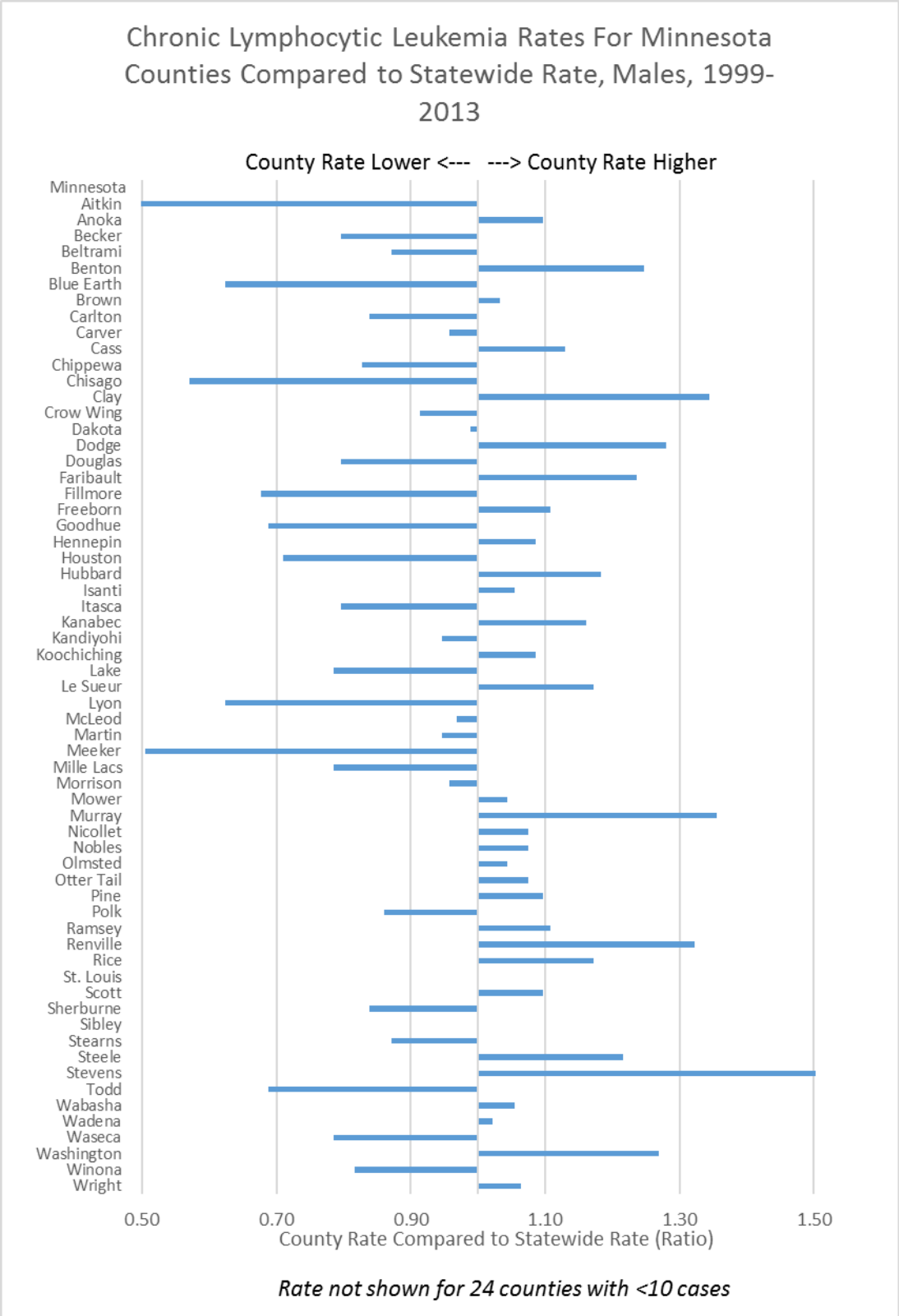

Chronic Lymphocytic Leukemia Rates For Minnesota Counties Compared to Statewide Rate, Males, 1999-2013
County Rate Lower <--- ---> County Rate Higher
Minnesota
Aitkin
Anoka
Becker
Beltrami
Benton
Blue Earth
Brown
Carlton
Carver
Cass
Chippewa
Chisago
Clay
Crow Wing
Dakota
Dodge
Douglas
Faribault
Fillmore
Freeborn
Goodhue
Hennepin
Houston
Hubbard
Isanti
Itasca
Kanabec
Kandiyohi
Koochiching
Lake
Le Sueur
Lyon
McLeod
Martin
Meeker
Mille Lacs
Morrison
Mower
Murray
Nicollet
Nobles
Olmsted
Otter Tail
Pine
Polk
Ramsey
Renville
Rice
St. Louis
Scott
Sherburne
Sibley
Stearns
Steele
Stevens
Todd
Wabasha
Wadena
Waseca
Washington
Winona
Wright
0.50
0.70
0.90
1.10
1.30
1.50
County Rate Compared to Statewide Rate (Ratio)
Rate not shown for 24 counties with <10 cases

Figure 7

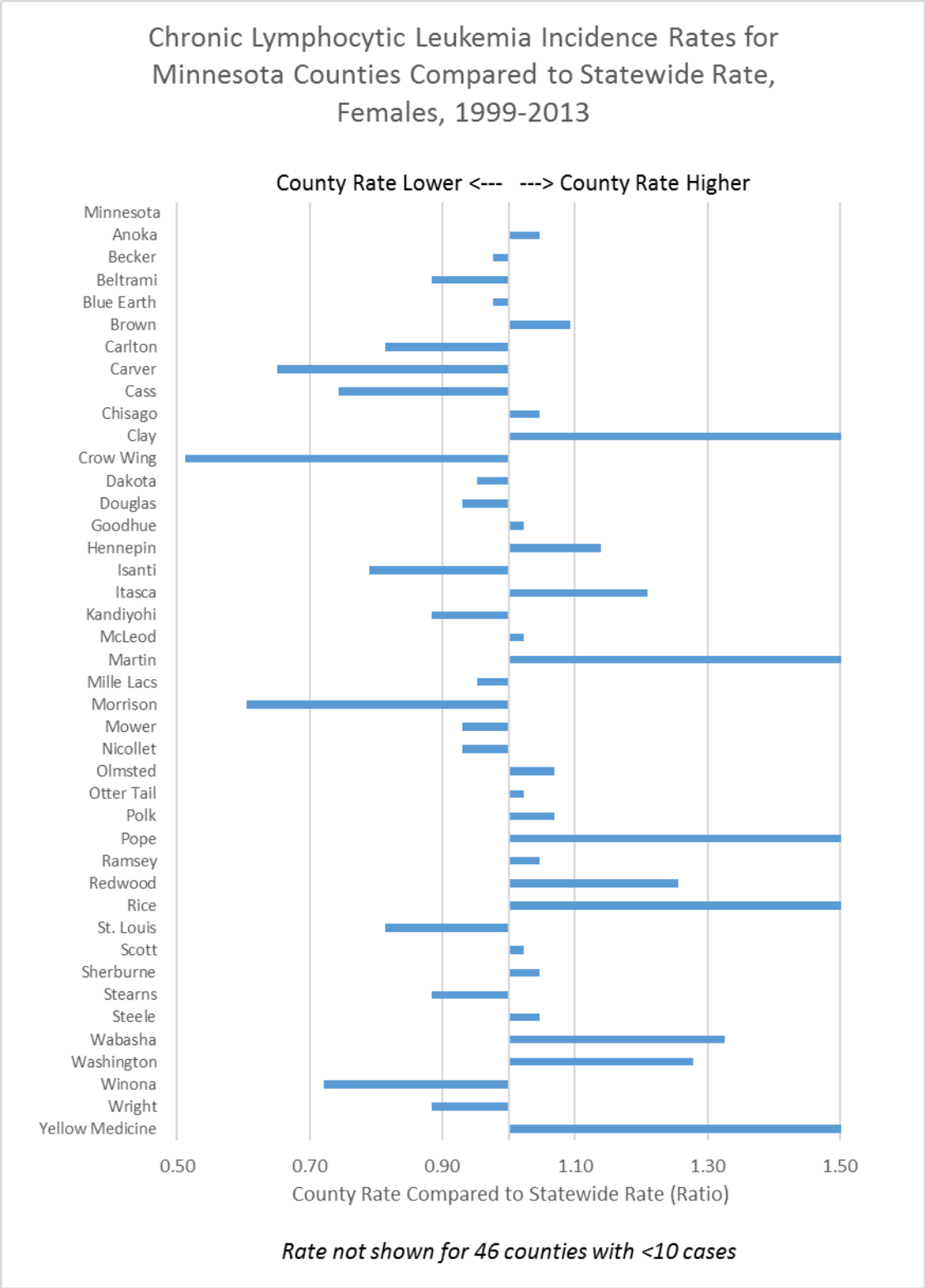
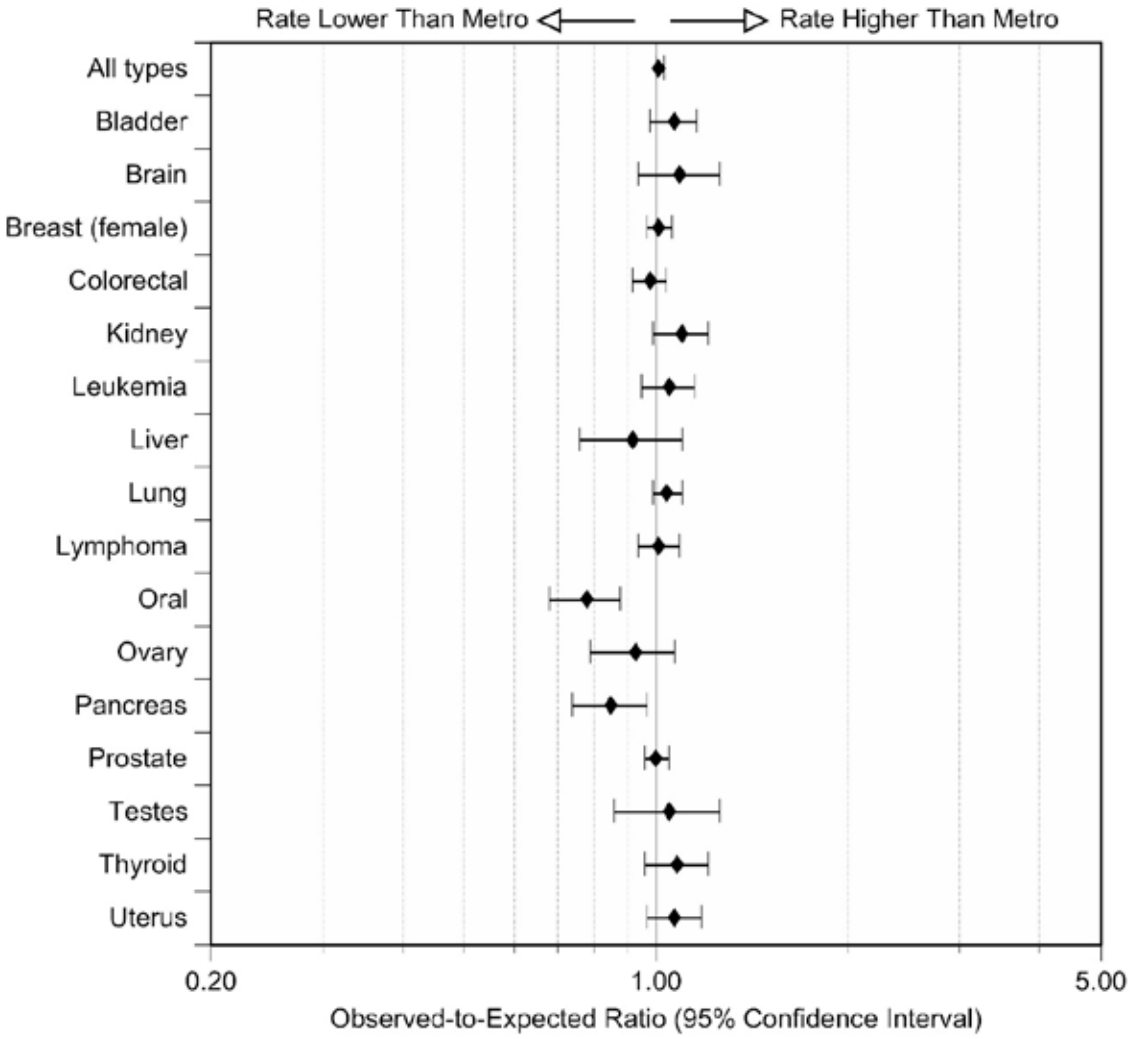

Chronic Lymphocytic Leukemia Incidence Rates for Minnesota Counties Compared to Statewide Rate, Females, 1999-2013
County Rate Lower <--- ---> County Rate Higher
Minnesota
Anoka
Becker
Beltrami
Blue Earth
Brown
Carlton
Carver
Cass
Chisago
Clay
Crow Wing
Dakota
Douglas
Goodhue
Hennepin
Isanti
Itasca
Kandiyohi
McLeod
Martin
Mille Lacs
Morrison
Mower
Nicollet
Olmsted
Otter Tail
Polk
Pope
Ramsey
Redwood
Rice
St. Louis
Scott
Sherburne
Stearns
Steele
Wabasha
Washington
Winona
Wright
Yellow Medicine
0.50
0.70
0.90
1.10
1.30
1.50
County Rate Compared to Statewide Rate (Ratio)
Rate not shown for 46 counties with <10 cases

Figure 8

Cancer Incidence Rates Among Residents of Eight Communities* With Known or Potential PFC Water Contamination Compared to Metro Area Rates, 1996-2012, Both Sexes Combined



*Included ZIPs: 55128 (Oakdale), 55042 (Lake Elmo, 55016 (Cottage Grove), 55125-55129 (Woodbury), 55055 (Newport), 55071 (St. Paul Park), 55033 (Hastings), 55075 (South St. Paul)

Figure 9

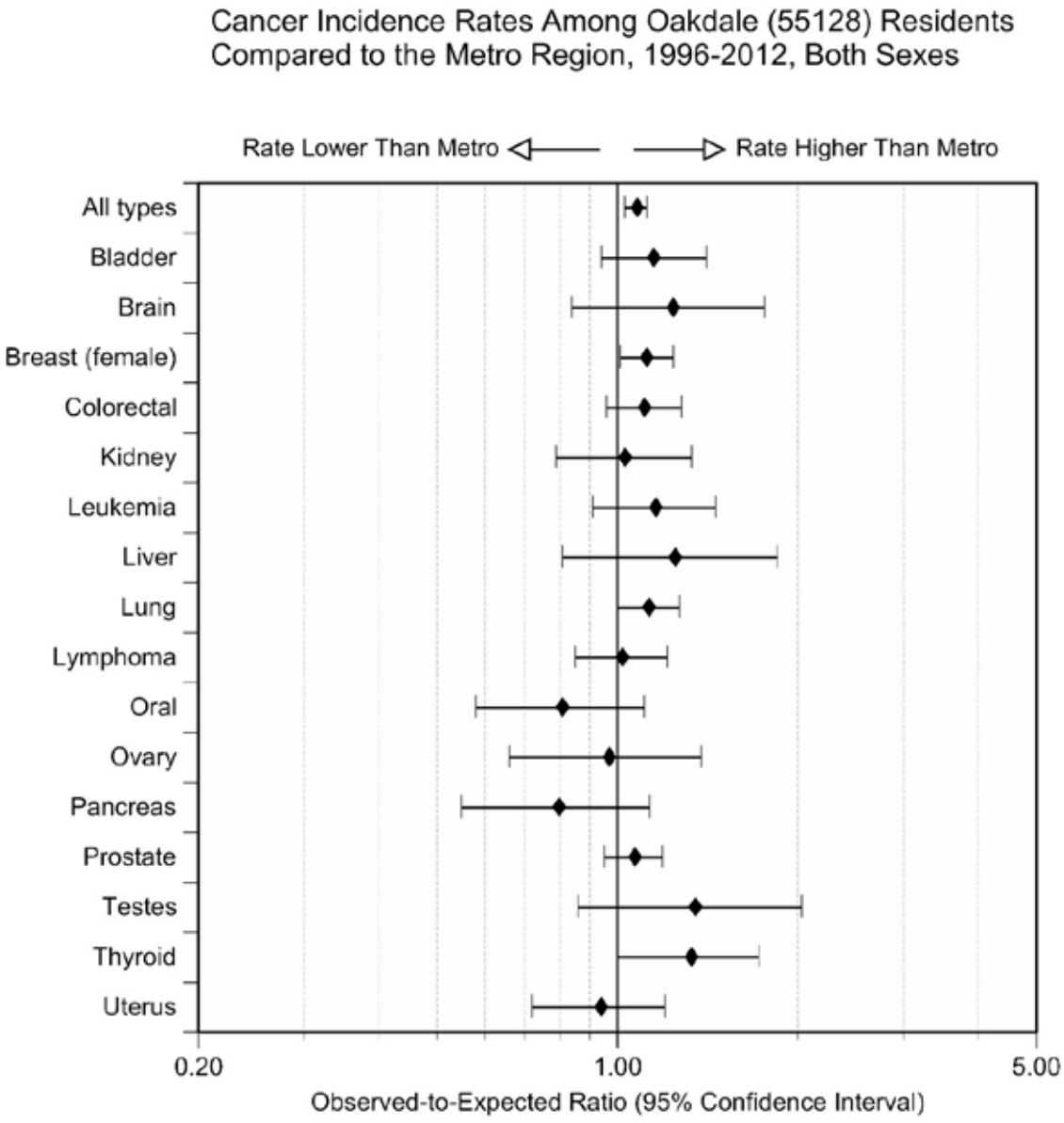

Cancer Incidence Rates Among Oakdale (55128) Residents
Compared to the Metro Region, 1996-2012, Both Sexes
Rate Lower Than Metro
Rate Higher Than Metro
All types
Bladder
Brain
Breast (female)
Colorectal
Kidney
Leukemia
Liver
Lung
Lymphoma
Oral
Ovary
Pancreas
Prostate
Testes
Thyroid
Uterus
0.20
1.00
5.00
Observed-to-Expected Ratio (95% Confidence Interval)

Figure 10

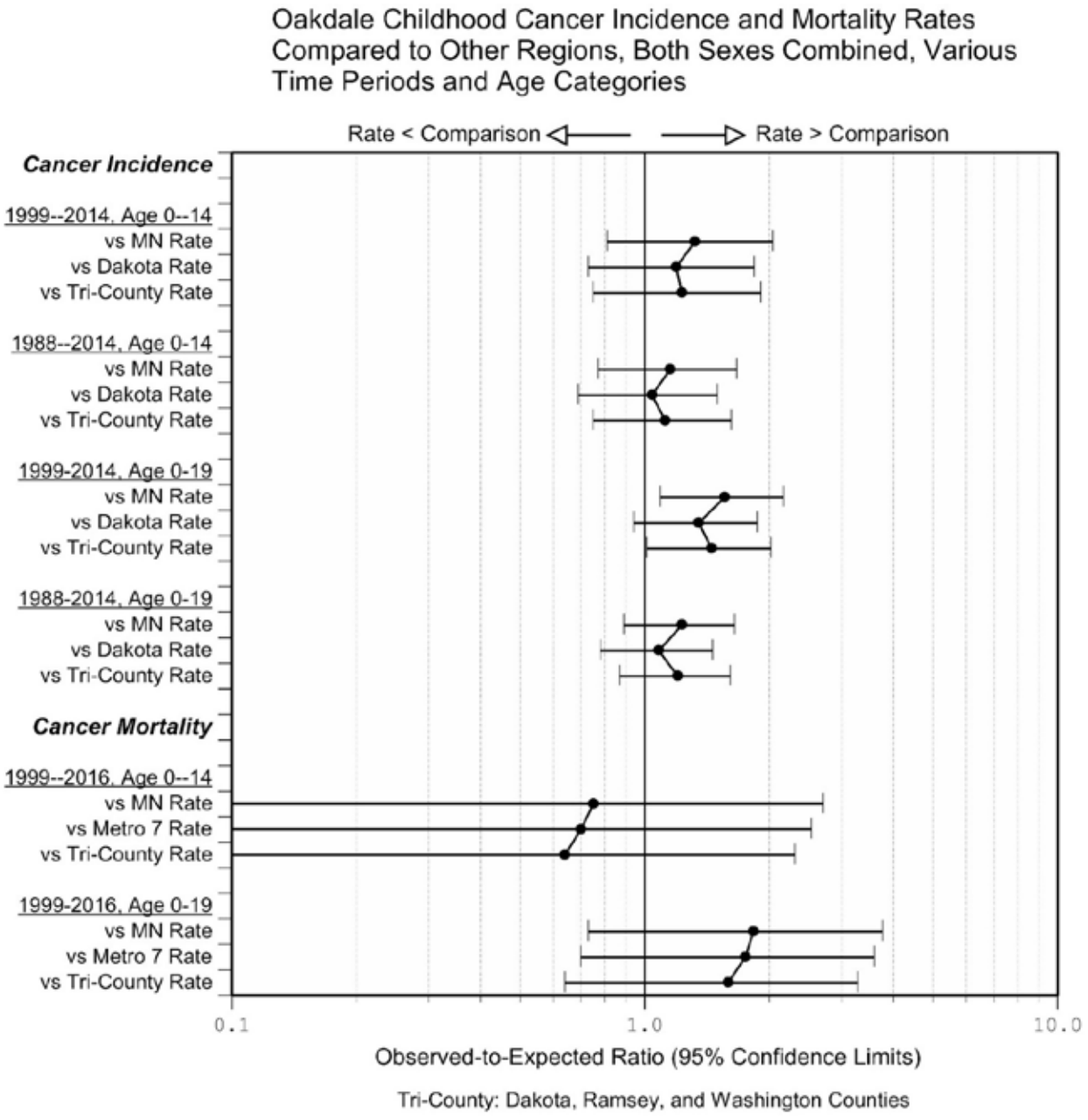

Oakdale Childhood Cancer Incidence and Mortality Rates Compared to Other Regions, Both Sexes Combined, Various Time Periods and Age Categories
Rate < Comparison
Rate > Comparison
Cancer Incidence
1999--2014, Age 0--14
vs MN Rate
vs Dakota Rate
vs Tri-County Rate
1988--2014, Age 0-14
vs MN Rate
vs Dakota Rate
vs Tri-County Rate
1999-2014, Age 0-19
vs MN Rate
vs Dakota Rate
vs Tri-County Rate
1988-2014, Age 0-19
vs MN Rate
vs Dakota Rate
vs Tri-County Rate
Cancer Mortality
1999--2016, Age 0--14
vs MN Rate
vs Metro 7 Rate
vs Tri-County Rate
1999-2016, Age 0-19
vs MN Rate
vs Metro 7 Rate
vs Tri-County Rate
0.1
1.0
10.0
Observed-to-Expected Ratio (95% Confidence Limits)
Tri-County: Dakota, Ramsey, and Washington Counties

Figure 11

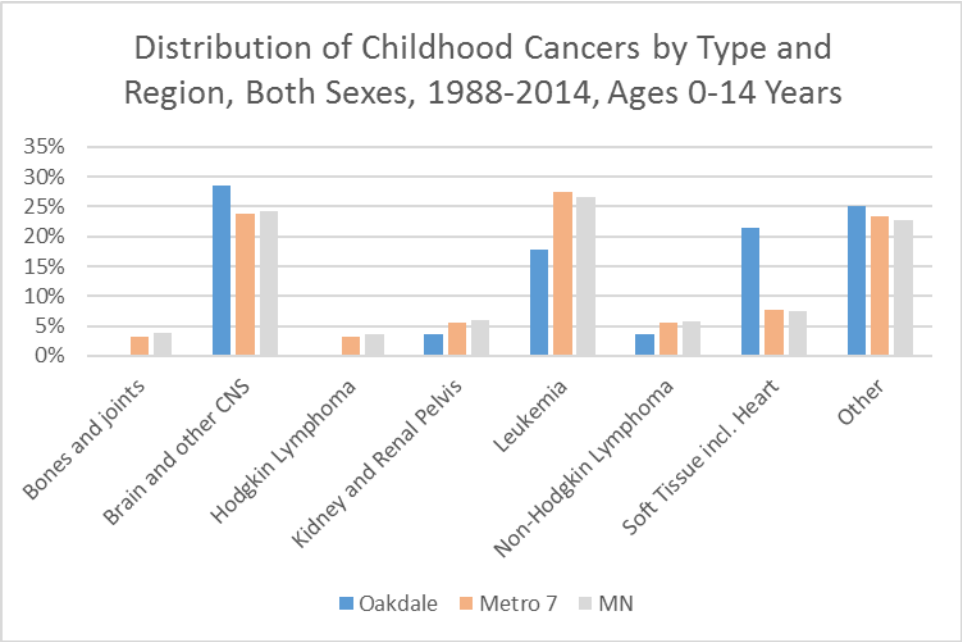


Figure 12

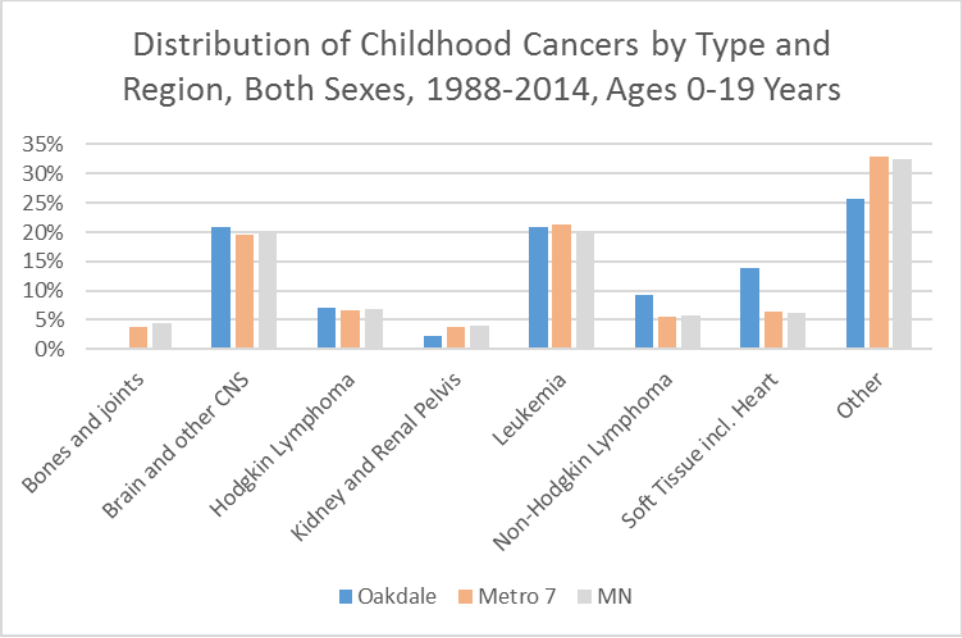


Figure 13

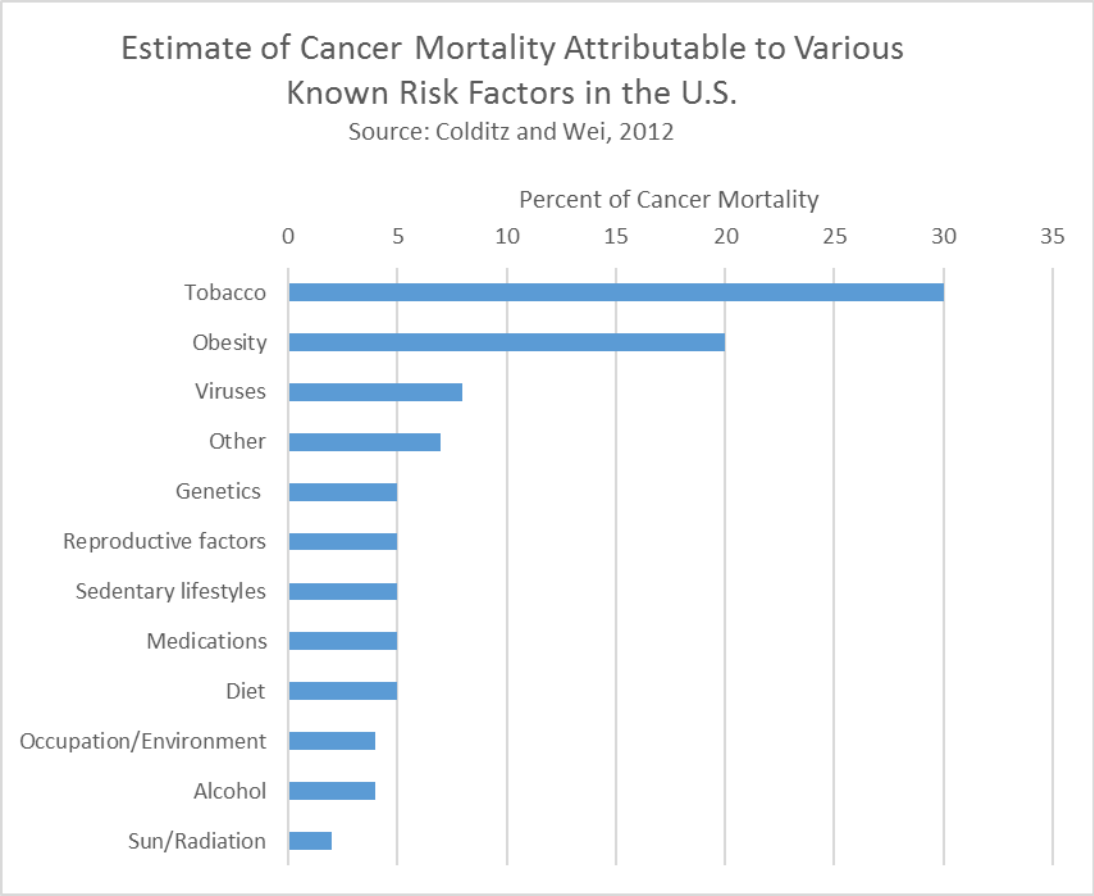
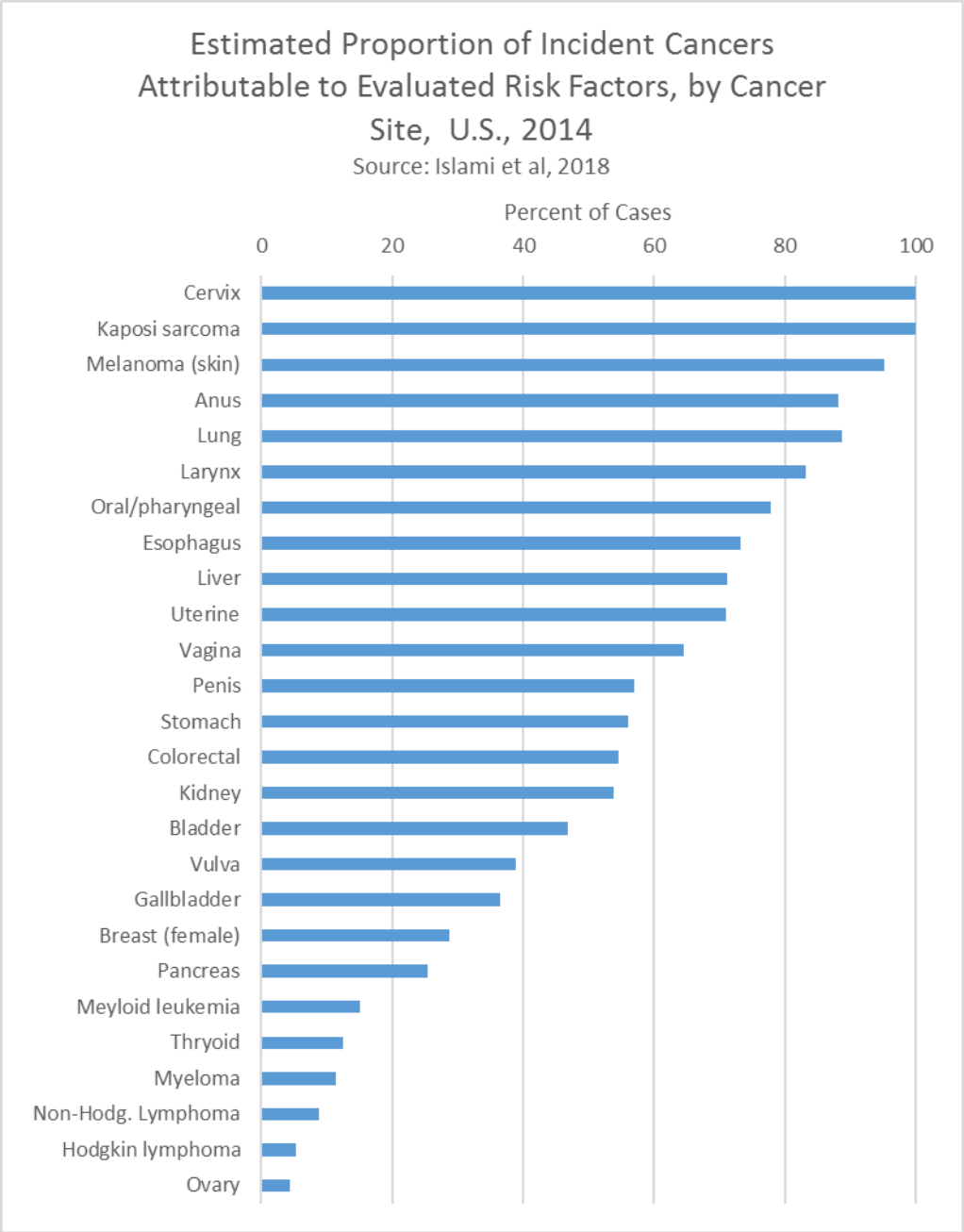

Estimate of Cancer Mortality Attributable to Various Known Risk Factors in the U.S.
Source: Colditz and Wei, 2012
Percent of Cancer Mortality
0
5
10
15
20
25
30
35
Tobacco
Obesity
Viruses
Other
Genetics
Reproductive factors
Sedentary lifestyles
Medications
Diet
Occupation/Environment
Alcohol
Sun/Radiation

Figure 14


Estimated Proportion of Incident Cancers Attributable to Evaluated Risk Factors, by Cancer Site, U.S., 2014
Source: Islami et al, 2018
Percent of Cases
0
20
40
60
80
100
Cervix
Kaposi sarcoma
Melanoma (skin)
Anus
Lung
Larynx
Oral/pharyngeal
Esophagus
Liver
Uterine
Vagina
Penis
Stomach
Colorectal
Kidney
Bladder
Vulva
Gallbladder
Breast (female)
Pancreas
Meyloid leukemia
Thryoid
Myeloma
Non-Hodg. Lymphoma
Hodgkin lymphoma
Ovary

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Shottenfeld D, Beebe-Dimmer J, Buffler P, Omenn G. 2013. Current perspective on the global and United States cancer burden attributable to lifestyle and environmental factors. Annual Reviews of Public Health 34:97-117. http://www.annualreviews.org/doi/abs/10.1146/annurev-publhealth-031912-114350