CANCER INCIDENCE STUDY

Cancer Incidence Statistical Review Investigating Bountiful, West Bountiful, Woods Cross, and North Salt Lake in Davis County, Utah Covering the Period from 1976 to 2011

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Prepared by the

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Other data and analytical tools used for this investigation were obtained from the Utah Environmental Public Health Tracking Network (UEPHTN). In addition, the UEPHTN provides geocoding services to UCR data. The UEPHTN is funded by a grant from the Centers for Disease Control and Prevention (CDC), Environmental Public Health Tracking Branch. The current UEPHTN award is number 1U38EH000954.

EXECUTIVE SUMMARY

Cancer is a dominating environmental public health concern. A function of epidemiology is to investigate cancer incidence, starting with a statistical review of cancer cases. In June 2013, the Davis County Health Department (DCHD) requested that the Environmental Epidemiology Program (EEP), within the Utah Department of Health (UDOH), assist in an investigation of public health concern the DCHD was conducting at that time. This cancer statistical review results from collaboration between the DCHD and the EEP.

This report presents a statistical review of cancer incidence among residents of portions of Bountiful, West Bountiful, Woods Cross, and North Salt Lake in Davis County, Utah. The EEP conducted this statistical review by comparing the cancer incidence. Six 6-year sequential time periods from 1976 to 2011 for 42 anatomical site-specific cancer categories were evaluated for excess rates. Those evaluations were conducted by comparing the observed number of cancer cases to the expected case counts for each time period and site category. The expected case counts were derived from the state age-adjusted cancer rate for the corresponding site and time period.

The EEP considers the incidence of cancer to be meaningfully elevated when two or more sequential time periods have statistically elevated cancer incidence counts, or when the final analytical period has a statistically elevated cancer incidence count. The EEP found that colon cancer, anal cancer among women, bone and joint cancer, cutaneous melanoma, breast cancer, and prostate cancer were elevated in the last (2006-2011) analytical period. Breast cancer was elevated for the last two analytical periods covering the time between 2000 and 2011. A historical cluster of prostate cancer between 1988 and 1999 was also detected.

This investigation provides a base-line status of cancer incidence in the study area. The EEP cannot link the pattern of cancer in the study area to current environmental exposures. A discussion of the most important known risk factors is provided.

INTRODUCTION

Cancer Incidence Statistical Reviews: A core function of epidemiology is to track and evaluate disease patterns. This function helps public health officials and policy-makers identify and assess communities with public health challenges, define public health priorities, monitor and evaluate public health actions, and discover knowledge about public health concerns (Dicker 2002; Stanbury et al. 2012; Thacker 2000; Thacker et al. 2012). Cancer is a dominating environmental public health concern. Public fear of cancer resulting from environmental hazards is reinforced by U.S. environmental regulatory actions that use cancer as a mechanism for making regulatory decisions (Morrone 2011). Public concerns about excess cancer risk often result in requests made to public health agencies to conduct investigations.

Public health conducts investigations of cancer incidence using one of several methods. The first is a cancer incidence statistical review. This method focuses on determining whether a particular community is experiencing more cancer than would be expected. A cancer statistical review is usually conducted by linking cancer registry and population data and evaluating trends. From the public health perspective, a cancer incidence statistical review is most useful in identifying community needs about cancer-related health education and awareness building, public health screening services, and other public health interventions. For the community, these kinds of studies empower the community to make improvements in governmental policymaking and health care services (Bell et al. 2006; Kingsley et al. 2007).

Another method available to public health practitioners is a cancer cluster investigation. Cancer cluster investigations focus on characterizing the size and extent of a population with known cancer excess and determining potential causal factors. The cancer cluster methodology involves linking many causal variables, usually collected by medical record review and individual surveys or interviews, followed by complex statistical analysis to identify the few variables that seem to explain the risk (Kingsley et al. 2007). Cluster investigations rarely result in important discoveries of causality (Goodman et al. 2012; Kingsley et al. 2007).

Study Objectives: This report presents a statistical review of cancer incidence among residents of portions of Bountiful, West Bountiful, Woods Cross, and North Salt Lake in Davis County, Utah. The Environmental Epidemiology Program (EEP), within the Utah Department of Health (UDOH), conducted this statistical review by analyzing periodic cancer rates and trends in rates of cancer incidence in the study area, compared to corresponding rates of the state of Utah. The objective of a statistical review is to identify significantly elevated cancer incidence rates. The statistical review methodology does not quantify the linkage of cancer rates to possible causal risk factors. Specific hazardous chemicals of concern and exposure risk are not addressed by this report.

Authority and Funding: In June 2013, the Davis County Health Department (DCHD) requested that the EEP conduct this cancer statistical review. The EEP worked with the DCHD to determine the scope of this statistical review. The DCHD health officer reviewed and approved the scope of the study and authorized the EEP to conduct the statistical review described in this report and to publish this report. The EEP provided progress reports to the DCHD staff and to the UDOH executive director during the scoping process. Once decisions on the study design were

concluded, the governor of Utah further authorized this investigation by request to the department.

Cancer, population, and geographic data for this investigation are collected, maintained, and made available by the Utah Environmental Public Health Tracking Network (UEPHTN). The UEPHTN also funds the SAS® and ArcGIS® analytical software application licenses that were used to conduct this investigation. The UEPHTN is funded by a grant from the Centers for Disease Control and Prevention (CDC) (UEPHTN 2012). Personnel time used to conduct this investigation was charged against state-funded EEP administrative funds. No federal funds were directly used to conduct this investigation.

DATA AND METHODS

Study Design: This investigation is a retrospective statistical review of cancer incidence among residents of the study area (defined below). Statistical reviews are not cancer cluster investigations, and lack the power to link cancer incidence to putative risk factors (Jekel et al. 1996; Kingsley et al. 2007; Mann 2003). Statistical reviews are a tool used by the EEP to review the health status of a population and assess public health activities.

The incidence of cancer, quantified in sequential analytical periods for each cancer category among residents of the study area, is compared to corresponding expected cancer incidence counts derived from the rates for the state of Utah. The study's null hypothesis is that the incidence of cancer in the study area is not significantly different from the expected incidence of cancer as determined by the corresponding rates for the state of Utah.

Decisions about scope and analytical parameters, such as defining the study area, analytical periods, and interpretation thresholds were made in collaboration with DCHD.

Study Population: The study population was defined as all residents living in the U.S. 2000 census tracts 49.011.126403, 49.011.126404, 49.011.126901, 49.011.126902, 49.011.127002, 49.011.127003, and 49.011.127004 (see Figure 1). These census tracts include the west side of Bountiful, and all of West Bountiful, Woods Cross, and North Salt Lake in Davis County, Utah. The 2012 estimated study area population is 44,860 persons (USCB 2013a, 2013b, 2013c).

Cancer Data: Cancer incidence data on people diagnosed with primary invasive cancer between 1976 and 2011 were obtained from the Utah Cancer Registry (UCR). The EEP receives cancer data for all invasive cancers on an annual basis. The UCR completes a rigorous data review for completion and quality before data are released to the EEP. The most recent years of data are not made available to the EEP until they have been finalized. The UCR data includes diagnostic information, patient demographics, and residential addresses of the cases, as well as information about the behavior of the cancer. The residential address information provided by the UCR includes the city and ZIP code (UCR 2013). The EEP geocodes each cancer case's residential address data to obtain an x- and y-coordinate for that address. Using those coordinates, the EEP is able to geo-reference cancer case data to their respective U.S. 2000 census block group areas (UEPHTN 2013).

Individuals with multiple primary invasive cancers have multiple records in the data set in sequential order. These cancers are distinguished by unique cancer registry tracking numbers and a cancer sequence number. The sequence number allows discrimination between the first cancer diagnosis and subsequent diagnoses (UCR 2013). Diagnostic coding of cancers includes the International Classification of Disease Oncology, 3rd Edition (ICD-O-3) codes for site, histology, and behavior (WHO 2012). The UCR groups cancer into 42 major cancer types by site following the guidance provided by the National Cancer Institute's Surveillance, Epidemiology, and End Results (SEER) Program (NCI 2012). These 42 UCR site codes are a convenient grouping for conducting surveillance analyses (UCR 2013).

Certain kinds of medical treatment for cancer and other diseases, such as radiation therapy, increase an individual's risk for developing subsequent leukemia, particularly myeloid leukemia (sometimes known as therapy-induced leukemia) (Godley and Larson 2008; Leone et al. 1999, 2011; Sill et al. 2011; Wilkins and Woodgate 2008). Myeloid leukemia cases that were the first of any sequence of cancers for an individual were included for this investigation. Myeloid leukemia cases that were subsequent to a previous cancer and could be therapy-induced leukemia were excluded.

Fifteen (15) cases of cancer that were in the area covered by ZIP codes 84010 (Bountiful), 84011 (Bountiful), 84054 (North Salt Lake) and 84087 (Woods Cross) were not geocode-able. The status of those cases with respect to inclusion with the study area cases could not be determined. The 15 cases included:

- 1 case of colon cancer
- 1 case of cancer of the rectum or recto-sigmoid junction
- 1 case of pancreatic cancer
- 1 case of lung or bronchial cancer
- 2 cases of cutaneous melanoma
- 1 case of a non-melanoma invasive skin cancer
- 1 case of breast cancer
- 1 case of cervical cancer
- 4 cases of prostate cancer
- 2 cases of non-Hodgkin lymphoma

These 15 cases represent approximately 0.2% of the total cases in those ZIP code areas, which contain the study area.

Statewide between 1976 and 2011, 194,772 invasive primary incident cancer cases reported among 170,204 individuals were registered by UCR. Of those, 3,023 persons living in the study area experienced 3,469 incident cancer cases between 1976 and 2011.

Population Data: The 2000 U.S. census divides Utah into 1,481 census block groups (USCB 2004) with a median population of 1,364 persons per census block group. Commercially available U.S. census population data for Utah for the 1970, 1980, 1990, 2000, and 2010 censuses (Geolytics 2002a, 2002b, 2002c; Geolytics 2012a, 2012b) were used to estimate annual age-group and sex population counts for each census block group for each intercensal year.

These estimates were made by applying annual population growth rates derived from the previous and subsequent decennial data. This method follows national population estimation guidelines (USCB 2013d).

Analytical Periods: Six 6-year analytical time periods (1976-1981, 1982-1987, 1988-1993, 1994-1999, 2000-2005, and 2006-2011) were evaluated for temporal cancer incidence trends.

Age Distribution Management: Cancer cases and population data were aggregated into six age group strata: 0-19 years of age, 20-34 years of age, 35-49 years of age, 50-64 years of age, 65-74 years of age, and 75 years and older. The cancer incidence by cancer type and population count for each age group, sex and analytical period strata for each of the study area census block groups were added together to generate the age group, sex, and analytical period cancer incidence and population counts for the study population.

Comparison Population: The comparison population for this investigation was defined as the state population excluding the study population. Similar to the process of developing the study population, the cancer incidence by cancer type and population count for each age group, sex, and analytical period for all of the census block groups in the state not included in the study population were added together to generate the comparison population. The 2012 estimated population for the state was 2,885,287 (USCB 2013a, 2013b, 2013c).

Socio-Economic Assessment of the Study and Comparison Populations: Social determinants of health are complex, integrated, and overlapping social structures and economic systems that are now thought to affect disease morbidity and mortality (Merletti et al. 2011; Song et al. 2011; Ward et al. 2004). Education level is an example. A better education leads to higher income and financial stability, which in turn leads to better health care access, leading to healthier lifestyles and to earlier detection and better treatment options for disease (Song et al. 2011). Of particular interest are the population's age, race, and ethnicity distributions; education level; and employment and financial stability (Merletti et al. 2011; Ward et al. 2004). Since 2000, the U.S. Census Bureau has used the American Community Survey (ACS) to sample a small percentage of the U.S. population each year to collect this kind of information. Data from the ACS 2007-2011 5-year estimates, and the ACS 2012 1-year estimates of population parameters were used to understand and compare selected demographic and economic characteristics that are important social determinants of cancer-related health. These risk factors contribute to the burden of disease, but are not the risk of concern for this investigation (USCB 2013a, 2013b, 2013c). Ideally, the social determinants of health metrics for the study area should be similar to the comparison population. If the social determinants of health between the two groups are disproportionate, they may confound the investigation of environmental risk assessment. The study area was compared to the county and state.

Estimate	Study Area	Davis County	State of Utah
2012 population (estimated people count)	44,860	315,809	2,855,287
Percent of population that are children 0-17 years old	68.3%	66.2%	68.9%
Percent of population that are elderly adults 65 years or older	9.8%	8.8%	9.5%
Percent of population that are of a minority race	11.0%	9.8%	11.9%
Percent of population that are Hispanic	8.7%	8.7%	13.3%
Percent of population born in Utah	67.1%	64.0%	61.8%
Percent of population born outside of the U.S.	5.7%	5.2%	8.4%
Percent of population who are not U.S. citizens	3.2%	2.6%	5.5%
Percent of adults that completed high school (have a diploma)	94.2%	96.0%	91.0%
Percent of adults with a college degree (including 2-year)	44.5%	46.5%	40.4%
Percent of adults and teenagers currently employed	67.5%	66.3%	63.9%
Percent of employed population in high exposure risk jobs	18.1%	21.3%	21.4%
Percent total population living in poverty	7.9%	8.4%	12.8%
Percent children 0-17 years old living in poverty	11.3%	10.3%	15.1%
Percent elderly adults 65 years or older living in poverty	5.7%	6.1%	6.8%
Percent of households at the same place 10 years or more	56.3%	56.0%	53.4%
Percent of households at the same place 20 years or more	38.6%	28.8%	28.3%
Percent of homes built before 1960	30.9%	18.3%	26.3%
Percent of homes that are single unites	76.8%	82.1%	74.7%
Percent of homes with high exposure heating systems	0.0%	0.3%	1.3%

Social determinants of health with more than a ten percent difference indicated that the study area has a different socioeconomic status than the state with respect to population demographics, citizenship, education, employment, and income. The study area housing is older, which may indicate more risk associated with older homes and older home technologies. The study area has a larger proportion of people with long residential tenure than the state which could indicate more influence by local environmental exposures on their health status. These indicators may denote a variety of barriers to health care services and preventive health knowledge including cultural, language, and legal barriers. This statistical review does not control for these potential confounders.

Behavioral Risk Factors: Tobacco use, chronic alcohol use, and obesity are well-known risk factors for many types of cancer. The UDOH conducts annual behavioral risk factor telephone surveys in Utah. These data are made available publicly on the Indicator-Based Information System for Public Health (IBIS-PH) website tabulated using a small area geography known as a health statistical unit. The health statistical units are aggregations of one or more ZIP code areas to achieve an annual population of at least 20,000 persons. The study area is within two health statistical units: Wood Cross-North Salt Lake, and Bountiful. The Behavioral Risk Factors Survey System (BRFSS) was queried for these behavioral risks as well as access and utilization of health care. All available years of data from 2001 through 2010 were used for the queries (UDOH 2012).

Estimate	Study Area	State of Utah
Percent of population who smoke	7.5%	11.5%
Percent of population who are chronic drinkers of alcohol	2.4%	2.9%
Percent of population who are overweight or obese (BMI 25+)	53.4%	56.4%
Percent of population who do not participate in leisure time physical activities (sports, hobbies, etc.)	13.2%	18.3%
Percent of population who do not get the recommended level of physical activity at work or at home	45.1%	43.3%
Percent of population with insufficient fruit in diet	70.5%	69.4%
Percent of population with insufficient vegetable in diet	73.1%	76.6%
Percent of population who do not have health care insurance	10.8%	18.8%
Percent of population who have not had a medical checkup in the past 12 months	38.1%	43.7%
Percent of population who have not received dental care in the past 12 months	26.1%	31.5%
Percent of population who are not able to get needed health care due to costs	9.9%	16.4%

These data suggest that the communities in the study area practice better life choices with respect to tobacco use, alcohol consumption, activity, and diet than the state population. The population in the study area also has better access to health care than the state population as a whole.

Indirect Age-Standardized Incidence Rates: The statistical analyses program SAS® version 9.2 was used to manage and analyze the data. The sex-specific and non-sex-specific indirect age-standardized incidence rate for each cancer type and analytical period was calculated using standard methods (Anderson and Rosenberg 1998; Jekel et al. 1996; Selvin 1996). This is the preferred method for analysis of disease with small case counts per analytical period. The expected incidence count and rate was computed by applying the comparison population incidence rate to the study area population for each analytical period using the indirect age-standardization method.

Standardized Incidence Ratio: The standardized incidence count of cancer for the study area was evaluated against the expected incidence count in the form of standardized incidence ratio (SIR). An SIR greater than one (1.0) indicates that the incidence of cancer in the study area population is greater than the proportional cancer incidence in the comparison population for that period of analysis. Conversely, an SIR less than one indicates that the incidence of cancer in the study area population is less than expected based on the comparison population's rate. Statistical significance is determined by applying the Byar's 95% confidence interval for the SIR (Breslow and Day 1987; Rothman and Boice 1979, 1982; Sahai and Khurshid 1983, 1996). For statistical validity, SIRs and corresponding 95% confidence intervals were only calculated for time periods with three or more cases (Bender et al. 1990; Caldwell 1990; Thun and Sinks 2004). The EEP is required to protect confidential data from unlawful disclosure; therefore, the EEP suppresses results for analytical time periods containing three or fewer cases (Langeberg et al. 2004).

An SIR for a specific cancer greater than one (1.0) and a confidence interval (expressed by the lower and upper limits) that does not include one (1.0) is considered to be statistically significant. Using a 95% confidence interval is a well-established standard for interpretation of an SIR with respect to statistical significance. Statistical significance focuses on minimizing false positive interpretations. A false positive occurs when the results appear to be elevated but in reality are random variation. It should be noted that an SIR may be statistically significant using this interpretation criteria, which may be a mathematical artifact and not biologically meaningful or relevant (Bender et al. 1990; Besag and Newell 1991). When conducting multiple analyses using the 95% confidence interval to interpret the data, one would expect one in twenty (5%) of the analyses to have a statistically significant interpretation as a result of random chance. For this investigation, 672 independent analyses (35 cancer type categories x 3 sex groups x 6 analytical time periods and 7 sex-specific cancer types x 1 sex group x 6 analytical periods) were conducted. This means as many as 33 (672 x 5%) of the statistically significant analytical results could be due to chance.

The EEP uses interpretive rules to distinguish results that are meaningfully significant from those that are not. The EEP considers the results meaningful when there are two consecutive time periods with a statistically significant result, or if the last analytical period is statistically significant (Bender et al. 1990; Caldwell 1990; Langeberg et al. 2004; Thun and Sinks 2004).

FINDINGS

The analytical results for the study area for each of the 42 cancer types and analytical periods are presented in Table 1. Seven cancer types were found to be elevated during at least one analytical period. Those types are: colon cancer, cancer of the anus, anal canal or anorectum, cancer of bone or joint tissue, cutaneous melanoma skin cancer, breast cancer, brain cancer, and prostate cancer.

Statistically Significant Cancer Results: Significantly elevated cancer incidence rates are indicated with an “S” in Table 1. Among males, prostate cancer rates were elevated for two consecutive analytical periods (1988-1993 and 1994-1999) in the middle of the study period, and for the last analytical time period (2006-2011). Cutaneous melanoma rates were elevated for two separated analytical periods (1994-1999 and 2006-2011) including the last analytical period. Colon cancer and bone or joint cancer rates were each elevated for the last analytical period.

Among females, breast cancer rates were elevated for the last two analytical periods consecutively (2000-2005 and 2006-2011). Rates of cancer of the colon, and cancer of the anus, anal canal, or anoractum were each elevated during the last analytical period (2006-2011). One analytical period (1994-1999) for brain cancer had an elevated rate in the middle of the study period.

For both sexes combined, the rates of colon cancer, bone and joint cancer, and cutaneous melanoma were elevated for the last study period. Brain cancer rates were elevated for the 1994-1999 analytical period.

Meaningful Cancer Results: The elevated rates for all types described above except brain cancer meet the criteria of either a temporal cluster (two or more consecutive analytical periods with elevated rates) or an emerging cluster (elevated rates in the last study period).

DISCUSSION

Cancer: Cancer is a broad group of more than 100 diseases that involve uncontrollable cell replication and growth. Often these cells are "undifferentiated," meaning they have lost their tissue-specific characteristics. As these cells grow to form tumor tissue, they invade nearby healthy tissue or spread through metastasis to other tissues. This invasion, or spread, disrupts the functions of the affected healthy tissues. Cancer cells may also produce metabolic products that can be transported to other parts of the body resulting in adverse health effects (ACS 2013; Goodman and Samet 2006; NCI 2013). The American Cancer Society (ACS) estimates that about one in two men and one in three women will develop cancer (all invasive sites) sometime in their life (lifetime risk) (ACS 2009; NCI 2011a, 2011b). In the U.S., cancer is the second leading cause of death (CDC 2012). Among all causes of death, approximately one in four men and one in five women will die of cancer (ACS 2009; NCI 2011a, 2011b). On average, about one in nine people will develop two or more cancers in his or her lifetime (Wilkins and Woodgate 2008).

Risk factors that contribute to the development of cancer include both inherent and external factors. Inherent factors include a variety of genetic susceptibilities. External factors include life choices and behaviors (e.g., tobacco use, alcohol use, poor diet, obesity, lack of physical activity, excessive sunlight exposure, and sexual behavior), medical conditions and medications, oncogenic pathogens, and chemical or radiological environmental exposures. Cancer may be the result of several factors interacting together with a triggering event (ACS 2013; Goodman and Samet 2006; NCI 2013).

Cancer of the lung and bronchus, cancer of the prostate, and non-Hodgkin lymphoma were elevated during one analytical period. While these findings were not found to have public health relevance, the following discussion of each of these cancer site categories is provided for public health education about cancer.

Cancer Sites: The ACS and the NCI each post booklets on their websites specific to cancer by type or anatomical site (ACS 2013; NCI 2013). People interested in more discussion can find these references on the web and links are provided in the reference section of this report. This report will provide a brief description focused on known important risk factors associated with the six cancer categories that had significant and meaningful results.

Colon cancer: Excluding skin cancer, colorectal cancer is the third most common cancer in both men and women in the U.S. One in twenty people will experience colorectal cancer sometime in their lifetime. The most important risk factors are:

- Being older than age 50
- African American or Eastern European racial or ethnic background
- Personal or family history of colorectal polyps

- Inflammatory bowel disease such as ulcerative colitis or Crohn's disease
- Certain inherited syndromes such as:
    - Familial adenomatous polyposis
    - Hereditary non-polyposis colon cancer (or Lynch syndrome)
    - Turcot syndrome
    - Peutz-Jeghers syndrome
    - MUTYH-associated polyposis
- Type 2 (non-insulin dependent) diabetes
- Diet high in red meats, processed meats, fried, or grilled foods; and low in vegetables, fruits, and whole grains
- Physical inactivity
- Obesity
- Smoking
- Heavy alcohol use

Anal cancer: Anal cancer is fairly rare. Treatment is often very effective, and most patients can be cured of the cancer, with some side effects. The most important risk factors are:

- Human papilloma virus (HPV) infections
- Human immunodeficiency virus (HIV) infections
- African American racial or ethnic background
- Being female
- Smoking
- Reduced immunity (medically suppressed immunity)

Bone and joint cancer: Primary cancers of the bones and joints account for less than 0.2% of all cancers. There are several different kinds of bone cancers including chondrosarcomas, osteosarcomas, Ewing tumors, malignant fibrous histiocytomas or fibrosarcomas, and several other very rare types. The most important known risk factors are:

- Certain genetic disorders
    - Li-Fraumeni syndrome
    - Rothmund-Thomson syndrome
    - Retinoblastoma
    - Multiple exostoses
    - History of chordomas
- Paget disease
- Exposure to ionizing radiation
- History of bone marrow transplantation

Bone injuries have not been shown to increase the risk for later bone cancer.

Cutaneous melanoma: Skin cancer is by far the most common of all cancers. Melanoma is just one of the different types of skin cancer. Melanoma accounts for less than five percent of skin cancer cases, but causes a large majority of skin cancer deaths. Overall, one in fifty people will experience cutaneous melanoma sometime in their lifetime. The most important known risk factors are:

- Caucasian racial or ethnic background, particularly with fair skin, freckling skin, or light colored hair
- Excessive exposure to ultraviolet (UV) light
- Presence of nevi (moles)
- Family history of melanoma
- Immune suppression
- Xeroderma pigmentosum syndrome

Breast cancer: Next to skin cancer, breast cancer is the most common cancer among American women. One in eight women will develop invasive breast cancer sometime during their lifetime. The most important known risk factors are:

- Being older than age 45
- The BRCA1 or BRCA2 inherited mutations
- Other inherited genetic mutations
- Family history of breast cancer
- Dense breast tissue and other benign breast conditions
- Early start of menstruation (before age of 12 years)
- History of radiation exposure to the chest
- History of use of diethylstilbestrol
- Not having children, or having children after the age of 30
- Use of certain birth control medications
- History of post-menopause combined hormone therapy
- Alcohol consumption
- Being overweight or obese
- Long-term heavy smoking
- Working at night

Investigation into the role of environmental chemical exposure in developing breast cancer is inconclusive. In theory, chemicals such pesticides and polychlorinated biphenyls may cause cancer in fatty tissues such as the breast tissue, but at this time research does not show a clear link between breast cancer risk and exposure to these substances.

Prostate cancer: Next to skin cancer, prostate cancer is the most common cancer among American men. One in six men will develop invasive prostate cancer sometime during their lifetime. The most important known risk factors are:

- Older than age 50
- African American or Jamaican racial or ethnic background
- Family history of prostate cancer
- The BRCA1 or BRCA2 inherited mutations
- Diet high in red meat or high-fat dairy products and low in fruits and vegetables
- Being overweight or obese
- Smoking
- Occupational exposures experienced by firefighters

Research has looked at the roles of prostate inflammation (prostatitis), history of sexually transmitted infections, and vasectomy in the development of prostate cancer. The evidence that these factors contribute to the risk for prostate cancer is inconclusive.

Limitations: The public often wants public health investigations to determine if cancer risk can be linked to a putative environmental concern. The methodology (indirect standardized incidence ratios) used in this investigation does not have the capability to definitively link the study area's elevated cancer rates to any inherent or external risk factors, including environmental exposures. These kinds of cancer statistical reviews are based on annual incidence data reported to the UCR. The incidence of cancer per year is dependent on diagnosis of clinically-manifested cancer. There are a number of limitations that impede this linkage. There is seldom any knowledge about the frequency, duration, or intensity of exposure to putative environmental concerns for cancer victims. Cancer can have a variable length latency period between the time of exposure and the time of the manifestation and diagnosis of cancer. Cancer can be present for some time before an individual seeks medical assistance that leads to diagnosis. There is seldom sufficient information available to statistically control for the many non-environmental factors that contribute to cancer risk, or exposure to other potential environmental risks that are not the putative environmental concern. For small populations, the incidence of cancer has a tendency to manifest arbitrary clusters. This tendency is a common phenomenon encountered when investigating the rate of rare diseases in a small population. Often, a few types of cancer may be statistically elevated for disparate periods, but that conclusion may change if the analytical periods are changed. Overcoming these limitations usually requires a comprehensive assessment of individual risk supported by a clear and consistent trend of elevated rates for a population.

This investigation used data from the UCR and U.S. Census. In Utah, the diagnosis of cancer for all site categories is reportable to the UCR. When a Utah resident seeks diagnosis, a report is generated and the UCR will follow-up on the report to confirm information and collect additional factors about the case. This process occurs when cases are diagnosed in Utah, but may not occur if a case is diagnosed outside of Utah. The UCR may contain records of incidence of cancer in people who recently moved to the study area prior to their diagnosis. The UCR may lack records on individuals who lived most of their life in the study area but moved elsewhere before seeking diagnosis and treatment. These situations create ascertainment biases. For the purposes of diagnosis, the EEP assumes that the ascertainment bias is non-systematic, meaning that the "move-in" and "move-out" situations balance each other. It is highly unlikely that this assumption is true in all cases and can be a significant limitation when the study population is small.

The EEP uses U.S. census data purchased from a commercial vendor. The vendor has re-tabulated 1980, 1990, and 2010 data for the 2000 census block groups in Utah. Re-tabulation involves population distribution weighting based on census blocks that may not be consistent through time. The EEP estimates intercensal population counts using linear regression between the known census tabulations. This methodology does not account for short-term population growth dynamics such as the zoning and development of a new subdivision, which can occur in just a few years.

An investigation that uses population-based summary data rather than individual-level data, such as presented in this report, is called an ecologic study by epidemiologists. An interpretation error commonly associated with ecologic investigations is to apply population-level risk findings to the individual. This kind of interpretation error is called an "ecologic fallacy." For example, this study found the risk of lung cancer to be 2.72 times higher for the study population. This risk metric should not be applied to individuals. An individual may have no risk or a risk several times higher than the population risk based on the individual's genetic makeup, behaviors, exposure history, and susceptibility or resiliency to cancer (Greenland 2001; Greenland and Robins 1994; Izquierdo and Schoenbach 2000; Morgenstern 1982, 1995; Rockhill 2005).

CONCLUSIONS AND RECOMMENDATIONS

Significantly elevated cancer incidence rates were found for colon cancer, bone and joint cancer, and cutaneous melanoma among both sexes. Among women, anal cancer and breast cancer were elevated, while among men prostate cancer was elevated. Colon cancer, cutaneous melanoma, breast cancer, and prostate cancer are types of cancer that often can be prevented through healthy lifestyle choices. For people developing these cancers, early detection and early intervention improve the prognosis for recovery and quality of life experience. Residents of the study area are better at practicing healthy life choices, but improvements can be made. Residents are encouraged to be aware of cancer risk and to work with their health care provider to be screened for these cancers.

The EEP recommends that DCHD work with the Utah Cancer Control Program (http://www.cancerutah.org; 800-717-1811) for screening and health education services that could be made available to the study area communities.

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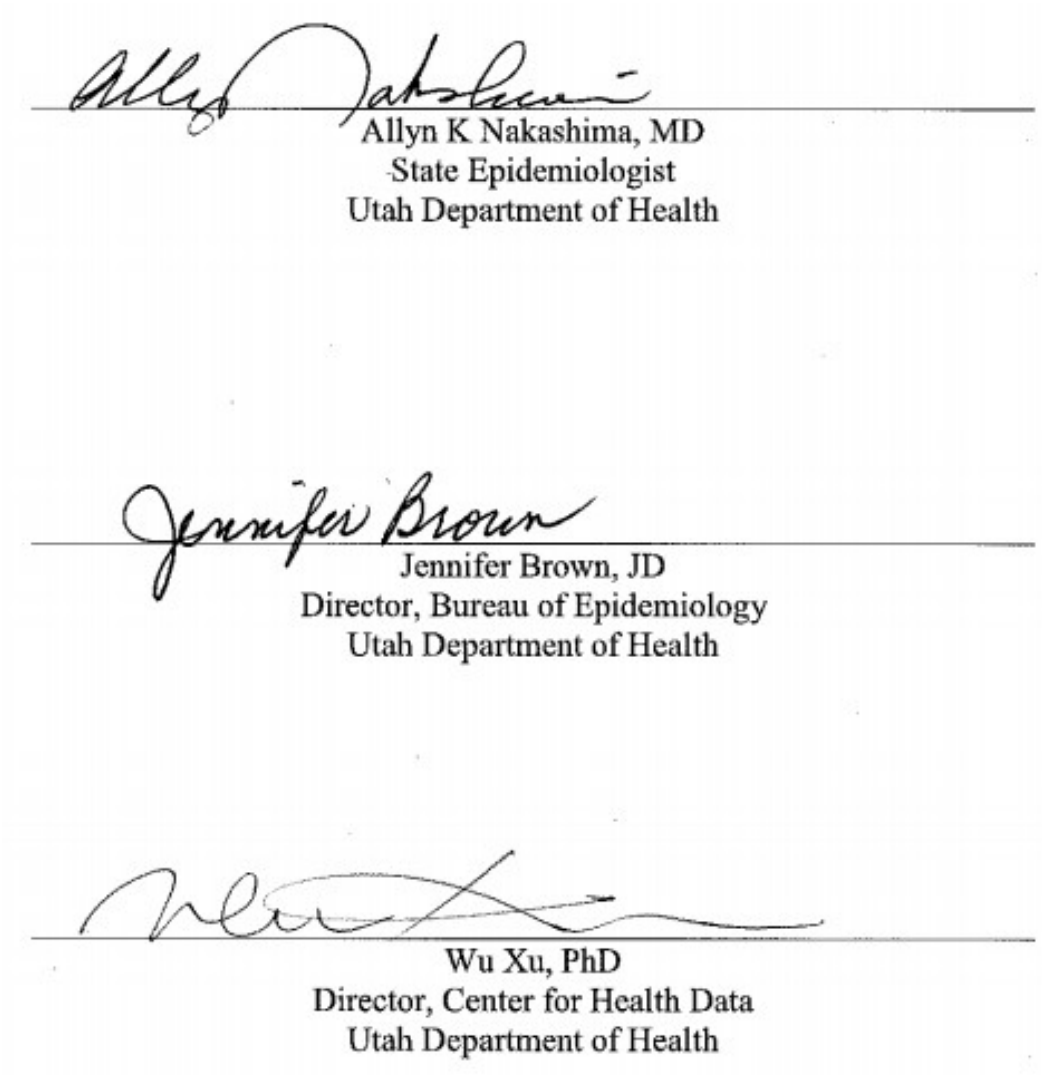
CERTIFICATION

This report titled "Cancer Incidence Statistical Review Investigating Bountiful, West Bountiful, Woods Cross, and North Salt Lake in Davis County, Utah Covering the Period from 1976 to 2011" was prepared by the Environmental Epidemiology Program, Utah Department of Health. This report covers an investigation of cancer incidence using standard and approved methodology and procedures existing at the time the investigation herein reported was begun. Editorial and technical review was completed by UDOH certifying reviewers and program partners.

Approved by:



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REFERENCES

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ACS (American Cancer Society). 2009. Lifetime risk of developing or dying from cancer web site. Available: http://www.cancer.org/Cancer/CancerBasics/lifetime-probability-of-developing-or-dying-from-cancer [accessed October 1, 2013].

ACS (American Cancer Society). 2013. Learn about cancer. Available: http://www.cancer.org/cancer/index [accessed October 1, 2013].

Anderson RN, Rosenberg HM. 1998. Age standardization for death rates: implementation of the year 2000 standard. *National Vital Statistics Report* 47(3):1-17.

Bell BS, Hoskins RE, Pickle LW, Wartenberg D. 2006. Current practices in spatial analysis of cancer data: mapping health statistics to inform policymakers and the public. *International Journal of Health Geographics* 5:49.

Bender AP, Williams AN, Johnson RA, Jagger HG. 1990. Appropriate public health response to clusters: the art of being responsibly responsive. *American Journal of Epidemiology* 132(Suppl 1):S48-S52.

Besag J, Newell J. 1991. The detection of clusters of rare disease. *Journal of the Royal Statistical Society, Part A* 154:143-155.

Breslow NE, Day NE. 1987. Rates and rate standardization. In: The design and analysis of cohort studies, Vol 2. IARC scientific publication No 82. (BreslowNE, Day NE, eds). Lyon, France: International Agency for Research on Cancer.

Caldwell GG. 1990. Twenty-two years of cancer cluster investigations at the Centers for Disease Control. *American Journal of Epidemiology* 132(Suppl 1):S43-S47.

CDC (Centers for Disease Control and Prevention). 2012. Leading causes of death. Available: http://www.cdc.gov/nchs/fastats/lcod.htm [accessed October 1, 2013].

Dicker RC. 2002. A brief review of the basic principles of epidemiology. In: Field Epidemiology, 2nd Ed. (Gregg MB, ed.). New York, NY: Oxford University Press.

Geolytics, Inc. 2002a. Census CD 1970, Release 2.0 on digital optical disk (CD). Information: http://www.GeoLytics.com [accessed October 1, 2013].

Geolytics, Inc. 2002b. Census CD 1990 long form in 2000 boundaries, Release 1.0 on digital optical disk (CD). Information: http://www.GeoLytics.com [accessed October 1, 2013].

Geolytics, Inc. 2002c. Census CD 2000 short form blocks for region 4 AK, AZ, CA, CO, HI, ID, MT, NV, NM, OR, UT, WA, and WY, release 1.0 on digital optical disk (CD). Information: http://www.GeoLytics.com [accessed October 1, 2013].

Geolytics, Inc. 2012a. Census CD 1980 long form in 2000 boundaries, Release 1.0 on digital optical disk (CD). Information: http://www.GeoLytics.com [accessed October 1, 2013].

Geolytics, Inc. 2012b. Summary file 1 2010 in 2000 boundaries on digital optical disk (CD). Information: http://www.GeoLytics.com [accessed October 1, 2013].

Godley LA, Larson RA. 2008. Therapy-induced myeloid leukemia. *Seminars in Oncology* 35(4):418-429.

Goodman M, Naiman JS, Goodman D, LaKind JS. 2012. Cancer clusters in the USA: what do the last twenty years of state and federal investigation tell us. *Critical Reviews in Toxicology* 42(6):474-490.

Goodman SN, Samet JM. 2006. Cause and cancer epidemiology. In: Cancer epidemiology and prevention, 3rd ed. (Schottenfeld D, Fraumeni JF, eds). New York City, NY: Oxford University Press

Greenland S. 2001. Ecologic versus individual-level sources of bias in ecologic estimates of contextual health effects. *International Journal of Epidemiology* 30(6):1343-1350.

Greenland S, Robins J. 1994. Ecologic studies – biases, misconceptions, and counter examples. *American Journal of Epidemiology* 139(8):747-760.

Izquierdo JN, Schoenbach VJ. 2000. The potential and limitations of data from population-based state cancer registries. *American Journal of Public Health* 90(5):695-698.

Jekel JF, Elmore JG, Katz DL. 1996. Epidemiology, biostatistics, and preventive medicine. Philadelphia, PA: WB Saunders Co.

Kingsley BS, Schmeichel KL, Rubin CH. 2007. An update on cancer cluster activities at the Centers for Disease Control and Prevention. *Environmental Health Perspectives* 115(1):167-171.

Langeberg W, Contreras J, Hatch M, Kinney G, Sukhan S, Williams G. 2004. Protocol for investigating cancer clusters in Utah. Salt Lake City, UT: Cancer Cluster Workgroup: Utah Department of Health.

Leone G, Fianchi L, Vozo MT. 2011. Therapy-related myeloid neoplasms. *Current Opinions in Oncolology* 23(6):672-680.

Leon G, Mele L, Pulsoni A, Equitani F, Pagano L. 1999. The incidence of secondary leukemia. *Haematologica* 84(10):937-945.

Mann CJ. 2003. Observation research methods. Research design II: cohort, cross sectional, and case-control studies. *Emergency Medicine Journal* 20:54-60.

Merletti F, Galassi C, Spadea T. 2011. The socioeconomic determinants of cancer. *Environmental Health* 10:S7.

Morgenstern H. 1982. Uses of ecologic analysis in epidemiologic research. *American Journal of Public Health* 72:1336-1344.

Morgenstern H. 1995. Ecologic studies in epidemiology: concepts, principles, and methods. *Annual Reviews of Public Health* 16:16-81.

Morrone M. 2011. From cancer to diarrhea: the moving target of public concern about environmental health risks. *Environmental Health Insights* 5:87-96.

NCI (National Cancer Institute). 2011a. SEER cancer statistics review 1975-2008. Lifetime risk (percent) of being diagnosed with cancer by site and race/ethnicity: males, 17 SEER areas, 2006-2008 (Table 1.15) and females, 17 SEER areas, 2006-2008 (Table 1.16). Available: http://seer.cancer.gov/csr/1975_2008/results_merged/topic_lifetime_risk_diagnosis.pdf [accessed October 1, 2013].

NCI (National Cancer Institute). 2011b. SEER cancer statistics review 1975-2008. Lifetime risk (percent) of dying from cancer by site and race/ethnicity: males, total US, 2006-2008 (Table 1.18) and females, total US, 2006-2008 (Table 1.19). 2011b. Available: http://seer.cancer.gov/csr/1975_2008/results_merged/topic_lifetime_risk_death.pdf [accessed October 1, 2013].

NCI (National Cancer Institute). 2012. Surveillance, Epidemiology, and End Results (SEER) Program. Available: http://seer.cancer.gov [accessed October 1, 2013].

NCI (National Cancer Institute). 2013. What you need to know about cancer. Available: http://www.cancer.gov/cancertopics/wyntk/cancer [accessed October 1, 2013].

Rockhill B. 2005. Theorizing about causes at the individual level while estimating effects at the population level: implications for prevention. *Epidemiology* 16(1):124-129.

Rothman KJ, Boice JD. 1979. Epidemiologic analysis with a programmable calculator. NIH Publication 79-1649. Washington, DC: Government Printing Office.

Rothman KJ, Boice JD. 1982. Epidemiologic analysis with a programmable calculator, New Edition. Boston, MA: Epidemiology Resources, Inc.

Sahai H, Khurshid A. 1983. Confidence intervals for the mean of a Poisson distribution: a review. *Biometrical Journal* 35:857-867.

Sahai H. Khurshid A. 1996. Statistics in epidemiology: methods, techniques and applications. Boca Raton, FL: CRC Press, Inc.

Selvin S. 1996. Chapter 1: Measures of risk: rates and probabilities. In: Monographs in epidemiology and biostatistics, Vol 25: statistical analysis of epidemiologic data. (Selvin S, ed.). Oxford, UK: Oxford University Press.

Sill H, Olipitz W, Zebisch A, Schulz E, Wolfler A. 2011. Therapy-related myeloid neoplasms: pathobiology and clinical characteristics. *British Journal of Pharmacology* 162(4):792-805.

Song R, Hall HI, Harrison KM, Sharpe TT, Lin LS, Dean HD. 2011. Identifying the impact of social determinants of health on disease rates using correlation analysis of area-based summary information. *Public Health Reports* 126(Suppl 3):70-80.

Stanbury M, Anderson H, Blackmore C, Fagliano J, Heumann M, Kass D, McGeehin M. 2012. Functions of environmental epidemiology and surveillance in state health departments. *Journal of Public Health Management and Practice* 18(5):453-460.

Thacker SB. 2000. Historical development. In: Principles and practice of public health surveillance, 2nd Ed. (Teutsch SM, Churchill RE, eds.). New York, NY: Oxford University Press.

Thacker SB, Qualters JR, Lee LM. 2012. Public health surveillance in the United States: evolution and challenges. *Morbidity and Mortality Weekly Report – Surveillance Supplement* 61(3):3-9

Thun MJ, Sinks T. 2004. Understanding cancer clusters. *CA Cancer Journal for Clinicians* 54(5):273-280.

UCR (Utah Cancer Registry). 2013. 2013 cancer dataset for the Utah Environmental Public Health Tracking Network: containing public use data records for primary in-situ Utah resident cancers from 1973 to 2011. Electronic data transfer. Information: http://ucr.utah.edu [accessed November 1, 2013].

UDOH (Utah Department of Health). 2012. Utah Indicator-Based Information System for Public Health (IBIS-PH). [See *Dataset Queries -> Health Surveys -> Behavioral Risk Factors Surveillance System*]. Available: http://ibis.health.utah.gov [accessed October 1, 2013].

UEPHTN (Utah Environmental Public Health Tracking Network). 2013. Utah Environmental Public Health Tracking Network website. Information: http://epht.health.utah.gov/epht-view/ [accessed October 1, 2013].

USCB (U.S. Census Bureau). 2004. Appendix A. Geographic terms and concepts in summary file 3: 2000 census population and housing, technical documentation. SF3/14 RV. Available: http://www.census.gov/prod/cen2000/doc/sf3.pdf [accessed October 1, 2013].

USCB (U.S. Census Bureau). 2013a. 2005-2009 American Community Survey 5-Year estimates: Table DP02 Selected social characteristics in the United States, 2005-2009. American Fact Finder. [The geographic location of the query included Utah state, Salt Lake county and 45 census tracts that were contained by the study area.] Available: http://factfinder2.census.gov [accessed October 1, 2013].

USCB(U.S. Census Bureau). 2013b. 2005-2009 American Community Survey 5-Year estimates: Table DP03 Selected economic characteristics, 2005-2009. American Fact Finder. [The geographic location of the query included Utah state, Salt Lake county and 45 census tracts that were contained by the study area.] Available: http://factfinder2.census.gov [accessed October 1, 2013].

USCB (U.S. Census Bureau). 2013c. 2005-2009 American Community Survey 5-Year estimates: Table DP05 ACS demographic and housing estimates, 2005-2009. American Fact Finder. [The geographic location of the query included Utah state, Salt Lake county and 45 census tracts that were contained by the study area.] Available: http://factfinder2.census.gov [accessed October 1, 2013].

USCB (U.S. Census Bureau). 2013d. Method for intercensal population estimates: 2000 to 2010. Available: http://www.census.gov/popest/methodology/2000-2010_Intercensal_Estimates_Methodology.pdf [accessed October 1, 2013].

Ward E, Jemal A, Cokkinides V, Singh GK, Cardinez C, Ghafoor A, Thun M. 2004. Cancer disparities by race/ethnicity and socioeconomic status. *CA A Cancer Journal for Clinicians* 54:78-93.

WHO (World Health Organization). 2012. International classification of diseases for oncology, 3rd Edition (ICD-O-3) website. Available: http://www.who.int/classifications/icd/adaptations/oncology/en/ [accessed October 1, 2013].

Wilkins KL, Woodgate RL. 2008. Preventing second cancers in cancer survivors. *Oncology Nursing Forum* 35(2):E12-E22.

Figure 1. Map of the southern part of Davis County, Utah showing the location of the study area for this investigation.

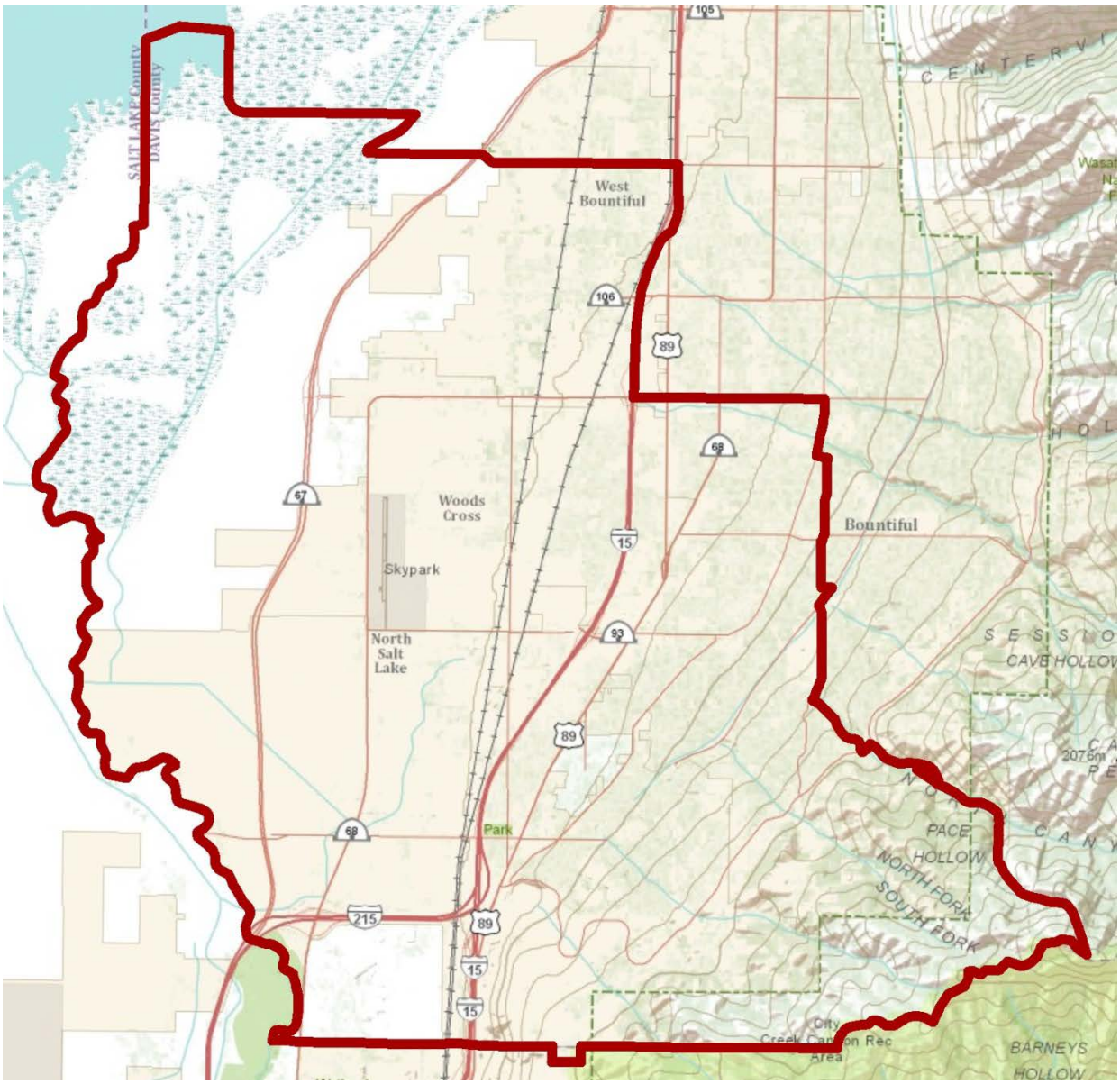

Table 1. Analysis of the incidence of primary cancer diagnoses among study area residents between 1976 and 2011 reported to the Utah Cancer Registry by site code. The total number of cases is 3,469. Case counts "≤3" means the count could be 0 to 3. Case counts ">3" means the case count was large enough to evaluate but is suppressed. Rates are indirect age-standardized incidence rates per 100,000 person-years. The SIRs are the standardized incidence ratios (SIR) with Byar's 95% confidence intervals (CI). Due to rounding, a lower confidence limit of 1.0 may or may not be significant. Significance is indicated by an "S." Sex code is "M" for male, "F" for female, and "B" for both.

Cancer Site	Analytical Period	Sex	Case Count	Rate	SIR	95% CI
01 Oral cavity and pharynx	1976-1981	M	≤3			
		F	>3	7.9	1.6	0.5 – 3.6
		B	8	6.2	0.7	0.3 – 1.3
	1982-1987	M	11	14.1	1.2	0.6 – 2.2
		F	4	5.1	1.2	0.3 – 3.1
		B	15	9.6	1.2	0.7 – 2.0
	1988-1993	M	>3	7.9	0.9	0.3 – 1.8
		F	≤3			
		B	9	5.1	0.8	0.4 – 1.5
	1994-1999	M	9	8.9	1.0	0.5 – 1.9
		F	4	3.8	0.9	0.3 – 2.4
		B	13	6.3	1.0	0.5 – 1.7
	2000-2005	M	6	5.2	0.6	0.2 – 1.3
		F	4	3.3	0.8	0.2 – 2.0
		B	10	4.3	0.7	0.3 – 1.2
	2006-2011	M	4	3.0	0.4	0.1 – 0.9
		F	4	2.9	0.7	0.2 – 1.8
		B	8	3.0	0.5	0.2 – 1.0

Table 1 (continued). Analysis of the incidence of primary cancer diagnoses among study area residents between 1976 and 2011 reported to the Utah Cancer Registry by site code. The total number of cases is 3,469. Case counts "≤3" means the count could be 0 to 3. Case counts ">3" means the case count was large enough to evaluate but is suppressed. Rates are indirect age-standardized incidence rates per 100,000 person-years. The SIRs are the standardized incidence ratios (SIR) with Byar's 95% confidence intervals (CI). Due to rounding, a lower confidence limit of 1.0 may or may not be significant. Significance is indicated by an "S." Sex code is "M" for male, "F" for female, and "B" for both.

Cancer Site	Analytical Period	Sex	Case Count	Rate	SIR	95% CI
02 Esophagus	1976-1981	M	≤3			
		F	≤3			
		B	≤3			
	1982-1987	M	≤3			
		F	≤3			
		B	>3	2.6	2.1	0.6 – 5.3
	1988-1993	M	≤3			
		F	≤3			
		B	≤3			
	1994-1999	M	≤3			
		F	≤3			
		B	≤3			
	2000-2005	M	≤3			
		F	≤3			
		B	>3	1.7	0.7	0.2 – 1.8
	2006-2011	M	>3	5.2	1.3	0.5 – 2.6
		F	≤3			
		B	7	2.6	1.1	0.4 – 2.2

Table 1 (continued). Analysis of the incidence of primary cancer diagnoses among study area residents between 1976 and 2011 reported to the Utah Cancer Registry by site code. The total number of cases is 3,469. Case counts "≤3" means the count could be 0 to 3. Case counts ">3" means the case count was large enough to evaluate but is suppressed. Rates are indirect age-standardized incidence rates per 100,000 person-years. The SIRs are the standardized incidence ratios (SIR) with Byar's 95% confidence intervals (CI). Due to rounding, a lower confidence limit of 1.0 may or may not be significant. Significance is indicated by an "S." Sex code is "M" for male, "F" for female, and "B" for both.

Cancer Site	Analytical Period	Sex	Case Count	Rate	SIR	95% CI
03 Stomach	1976-1981	M	≤3			
		F	>3	7.1	1.8	0.5 – 4.5
		B	7	5.9	1.2	0.5 – 2.4
	1982-1987	M	>3	6.6	1.2	0.4 – 2.8
		F	≤3			
		B	7	4.7	1.0	0.4 – 2.1
	1988-1993	M	8	9.2	1.8	0.8 – 3.5
		F	4	4.5	1.4	0.4 – 3.5
		B	12	6.8	1.6	0.8 – 2.8
	1994-1999	M	>3	8.9	2.0	0.9 – 3.8
		F	≤3			
		B	11	5.3	1.4	0.7 – 2.5
	2000-2005	M	7	5.9	1.3	0.5 – 2.8
		F	5	4.0	1.5	0.5 – 3.5
		B	12	5.0	1.4	0.7 – 2.5
	2006-2011	M	≤3			
		F	>3	2.9	1.1	0.3 – 2.8
		B	>3	2.2	0.7	0.2 – 1.4

Table 1 (continued). Analysis of the incidence of primary cancer diagnoses among study area residents between 1976 and 2011 reported to the Utah Cancer Registry by site code. The total number of cases is 3,469. Case counts "≤3" means the count could be 0 to 3. Case counts ">3" means the case count was large enough to evaluate but is suppressed. Rates are indirect age-standardized incidence rates per 100,000 person-years. The SIRs are the standardized incidence ratios (SIR) with Byar's 95% confidence intervals (CI). Due to rounding, a lower confidence limit of 1.0 may or may not be significant. Significance is indicated by an "S." Sex code is "M" for male, "F" for female, and "B" for both.

Cancer Site	Analytical Period	Sex	Case Count	Rate	SIR	95% CI
04 Small intestine	1976-1981	M	≤3			
		F	≤3			
		B	≤3			
	1982-1987	M	≤3			
		F	≤3			
		B	≤3			
	1988-1993	M	≤3			
		F	≤3			
		B	≤3			
	1994-1999	M	≤3			
		F	≤3			
		B	≤3			
	2000-2005	M	≤3			
		F	≤3			
		B	>3	1.7	1.1	0.3 – 2.9
	2006-2011	M	≤3			
		F	≤3			
		B	≤3			

Table 1 (continued). Analysis of the incidence of primary cancer diagnoses among study area residents between 1976 and 2011 reported to the Utah Cancer Registry by site code. The total number of cases is 3,469. Case counts "≤3" means the count could be 0 to 3. Case counts ">3" means the case count was large enough to evaluate but is suppressed. Rates are indirect age-standardized incidence rates per 100,000 person-years. The SIRs are the standardized incidence ratios (SIR) with Byar's 95% confidence intervals (CI). Due to rounding, a lower confidence limit of 1.0 may or may not be significant. Significance is indicated by an "S." Sex code is "M" for male, "F" for female, and "B" for both.

Cancer Site	Analytical Period	Sex	Case Count	Rate	SIR	95% CI
05 Colon	1976-1981	M	15	24.6	1.5	0.9 – 2.5
		F	13	22.9	1.2	0.6 – 2.1
		B	28	23.9	1.4	0.9 – 2.0
	1982-1987	M	19	25.7	1.3	0.8 – 2.0
		F	17	23.3	1.1	0.6 – 1.8
		B	36	24.5	1.2	0.8 – 1.6
	1988-1993	M	18	20.9	1.0	0.6 – 1.6
		F	16	18.1	0.9	0.5 – 1.4
		B	34	19.5	0.9	0.7 – 1.3
	1994-1999	M	21	20.6	1.0	0.6 – 1.6
		F	20	18.7	0.9	0.6 – 1.4
		B	41	19.6	1.0	0.7 – 1.3
	2000-2005	M	19	16.1	0.8	0.5 – 1.2
		F	33	26.6	1.3	0.9 – 1.8
		B	52	21.5	1.0	0.8 – 1.4
	2006-2011	M	36	26.6	1.5	1.1 – 2.1 **S**
		F	40	28.8	1.6	1.1 – 2.1 **S**
		B	76	27.7	1.6	1.2 – 1.9 **S**

Table 1 (continued). Analysis of the incidence of primary cancer diagnoses among study area residents between 1976 and 2011 reported to the Utah Cancer Registry by site code. The total number of cases is 3,469. Case counts "≤3" means the count could be 0 to 3. Case counts ">3" means the case count was large enough to evaluate but is suppressed. Rates are indirect age-standardized incidence rates per 100,000 person-years. The SIRs are the standardized incidence ratios (SIR) with Byar's 95% confidence intervals (CI). Due to rounding, a lower confidence limit of 1.0 may or may not be significant. Significance is indicated by an "S." Sex code is "M" for male, "F" for female, and "B" for both.

Cancer Site	Analytical Period	Sex	Case Count	Rate	SIR	95% CI
06 Rectum and recto-sigmoid junction	1976-1981	M	6	9.7	1.2	0.4 – 2.6
		F	4	6.9	0.9	0.2 – 2.3
		B	10	8.4	1.0	0.5 – 1.9
	1982-1987	M	6	7.9	0.8	0.3 – 1.8
		F	7	9.3	1.2	0.5 – 2.5
		B	13	8.6	1.0	0.5 – 1.7
	1988-1993	M	9	10.3	1.0	0.5 – 1.9
		F	6	6.7	0.9	0.3 – 2.0
		B	15	8.5	1.0	0.5 – 1.6
	1994-1999	M	11	10.8	1.2	0.6 – 2.1
		F	9	8.4	1.1	0.5 – 2.0
		B	20	9.6	1.1	0.7 – 1.8
	2000-2005	M	9	7.7	0.9	0.4 – 1.7
		F	9	7.4	1.1	0.5 – 2.0
		B	18	7.5	1.0	0.6 – 1.5
	2006-2011	M	12	9.0	0.9	0.5 – 1.6
		F	13	9.5	1.4	0.7 – 2.4
		B	25	9.3	1.1	0.7 – 1.7

Table 1 (continued). Analysis of the incidence of primary cancer diagnoses among study area residents between 1976 and 2011 reported to the Utah Cancer Registry by site code. The total number of cases is 3,469. Case counts "≤3" means the count could be 0 to 3. Case counts ">3" means the case count was large enough to evaluate but is suppressed. Rates are indirect age-standardized incidence rates per 100,000 person-years. The SIRs are the standardized incidence ratios (SIR) with Byar's 95% confidence intervals (CI). Due to rounding, a lower confidence limit of 1.0 may or may not be significant. Significance is indicated by an "S." Sex code is "M" for male, "F" for female, and "B" for both.

Cancer Site	Analytical Period	Sex	Case Count	Rate	SIR	95% CI
07 Anus, anal canal and anorectum	1976-1981	M	≤3			
		F	≤3			
		B	≤3			
	1982-1987	M	≤3			
		F	≤3			
		B	≤3			
	1988-1993	M	≤3			
		F	≤3			
		B	≤3			
	1994-1999	M	≤3			
		F	≤3			
		B	≤3			
	2000-2005	M	≤3			
		F	≤3			
		B	≤3			
	2006-2011	M	≤3			
		F	>3	3.7	3.3	1.1 – 7.7 **S**
		B	>3	2.2	2.5	0.9 – 5.5

Table 1 (continued). Analysis of the incidence of primary cancer diagnoses among study area residents between 1976 and 2011 reported to the Utah Cancer Registry by site code. The total number of cases is 3,469. Case counts "≤3" means the count could be 0 to 3. Case counts ">3" means the case count was large enough to evaluate but is suppressed. Rates are indirect age-standardized incidence rates per 100,000 person-years. The SIRs are the standardized incidence ratios (SIR) with Byar's 95% confidence intervals (CI). Due to rounding, a lower confidence limit of 1.0 may or may not be significant. Significance is indicated by an "S." Sex code is "M" for male, "F" for female, and "B" for both.

Cancer Site	Analytical Period	Sex	Case Count	Rate	SIR	95% CI
08 Liver and interhepatic bile duct	1976-1981	M	≤3			
		F	≤3			
		B	≤3			
	1982-1987	M	≤3			
		F	≤3			
		B	≤3			
	1988-1993	M	≤3			
		F	≤3			
		B	≤3			
	1994-1999	M	>3	5.9	2.5	0.9 – 5.5
		F	≤3			
		B	7	3.4	1.6	0.6 – 3.3
	2000-2005	M	≤3			
		F	≤3			
		B	≤3			
	2006-2011	M	6	4.5	0.9	0.3 – 1.9
		F	4	2.9	1.3	0.3 – 3.3
		B	10	3.7	1.0	0.5 – 1.9

Table 1 (continued). Analysis of the incidence of primary cancer diagnoses among study area residents between 1976 and 2011 reported to the Utah Cancer Registry by site code. The total number of cases is 3,469. Case counts "≤3" means the count could be 0 to 3. Case counts ">3" means the case count was large enough to evaluate but is suppressed. Rates are indirect age-standardized incidence rates per 100,000 person-years. The SIRs are the standardized incidence ratios (SIR) with Byar's 95% confidence intervals (CI). Due to rounding, a lower confidence limit of 1.0 may or may not be significant. Significance is indicated by an "S." Sex code is "M" for male, "F" for female, and "B" for both.

Cancer Site	Analytical Period	Sex	Case Count	Rate	SIR	95% CI
09 Gallbladder and biliary bile ducts	1976-1981	M	≤3			
		F	≤3			
		B	≤3			
	1982-1987	M	≤3			
		F	≤3			
		B	≤3			
	1988-1993	M	≤3			
		F	≤3			
		B	≤3			
	1994-1999	M	≤3			
		F	≤3			
		B	≤3			
	2000-2005	M	>3	3.4	2.5	0.7 – 6.4
		F	≤3			
		B	>3	2.4	1.6	0.6 – 3.5
	2006-2011	M	≤3			
		F	>3	3.6	1.9	0.6 – 4.5
		B	>3	2.2	1.3	0.5 – 2.9

Table 1 (continued). Analysis of the incidence of primary cancer diagnoses among study area residents between 1976 and 2011 reported to the Utah Cancer Registry by site code. The total number of cases is 3,469. Case counts "≤3" means the count could be 0 to 3. Case counts ">3" means the case count was large enough to evaluate but is suppressed. Rates are indirect age-standardized incidence rates per 100,000 person-years. The SIRs are the standardized incidence ratios (SIR) with Byar's 95% confidence intervals (CI). Due to rounding, a lower confidence limit of 1.0 may or may not be significant. Significance is indicated by an "S." Sex code is "M" for male, "F" for female, and "B" for both.

Cancer Site	Analytical Period	Sex	Case Count	Rate	SIR	95% CI
10 Pancreas	1976-1981	M	≤3			
		F	≤3			
		B	≤3			
	1982-1987	M	>3	6.6	1.1	0.3 – 2.5
		F	≤3			
		B	8	5.4	0.9	0.4 – 1.8
	1988-1993	M	≤3			
		F	>3	4.6	0.8	0.2 – 2.0
		B	7	4.0	0.7	0.3 – 1.4
	1994-1999	M	7	6.9	1.2	0.5 – 2.4
		F	4	3.7	0.7	0.2 – 1.9
		B	11	5.3	1.0	0.5 – 1.7
	2000-2005	M	14	11.8	1.8	1.0 – 2.9
		F	6	4.8	0.8	0.3 – 1.7
		B	20	8.3	1.3	0.8 – 1.9
	2006-2011	M	6	4.4	0.6	0.2 – 1.2
		F	14	10.1	1.3	0.7 – 2.2
		B	20	7.3	1.0	0.6 – 1.5

Table 1 (continued). Analysis of the incidence of primary cancer diagnoses among study area residents between 1976 and 2011 reported to the Utah Cancer Registry by site code. The total number of cases is 3,469. Case counts "≤3" means the count could be 0 to 3. Case counts ">3" means the case count was large enough to evaluate but is suppressed. Rates are indirect age-standardized incidence rates per 100,000 person-years. The SIRs are the standardized incidence ratios (SIR) with Byar's 95% confidence intervals (CI). Due to rounding, a lower confidence limit of 1.0 may or may not be significant. Significance is indicated by an "S." Sex code is "M" for male, "F" for female, and "B" for both.

Cancer Site	Analytical Period	Sex	Case Count	Rate	SIR	95% CI
11 Other digestive system	1976-1981	M	≤3			
		F	≤3			
		B	≤3			
	1982-1987	M	≤3			
		F	≤3			
		B	≤3			
	1988-1993	M	≤3			
		F	≤3			
		B	≤3			
	1994-1999	M	≤3			
		F	≤3			
		B	≤3			
	2000-2005	M	≤3			
		F	≤3			
		B	≤3			
	2006-2011	M	≤3			
		F	≤3			
		B	>3	1.8	1.4	0.4 – 3.2

Table 1 (continued). Analysis of the incidence of primary cancer diagnoses among study area residents between 1976 and 2011 reported to the Utah Cancer Registry by site code. The total number of cases is 3,469. Case counts "≤3" means the count could be 0 to 3. Case counts ">3" means the case count was large enough to evaluate but is suppressed. Rates are indirect age-standardized incidence rates per 100,000 person-years. The SIRs are the standardized incidence ratios (SIR) with Byar's 95% confidence intervals (CI). Due to rounding, a lower confidence limit of 1.0 may or may not be significant. Significance is indicated by an "S." Sex code is "M" for male, "F" for female, and "B" for both.

Cancer Site	Analytical Period	Sex	Case Count	Rate	SIR	95% CI
12 Larynx	1976-1981	M	≤3			
		F	≤3			
		B	>3	3.0	1.8	0.5 – 4.5
	1982-1987	M	≤3			
		F	≤3			
		B	≤3			
	1988-1993	M	≤3			
		F	≤3			
		B	≤3			
	1994-1999	M	≤3			
		F	≤3			
		B	≤3			
	2000-2005	M	≤3			
		F	≤3			
		B	≤3			
	2006-2011	M	≤3			
		F	≤3			
		B	≤3			

Table 1 (continued). Analysis of the incidence of primary cancer diagnoses among study area residents between 1976 and 2011 reported to the Utah Cancer Registry by site code. The total number of cases is 3,469. Case counts "≤3" means the count could be 0 to 3. Case counts ">3" means the case count was large enough to evaluate but is suppressed. Rates are indirect age-standardized incidence rates per 100,000 person-years. The SIRs are the standardized incidence ratios (SIR) with Byar's 95% confidence intervals (CI). Due to rounding, a lower confidence limit of 1.0 may or may not be significant. Significance is indicated by an "S." Sex code is "M" for male, "F" for female, and "B" for both.

Cancer Site	Analytical Period	Sex	Case Count	Rate	SIR	95% CI
13 Lung and bronchus	1976-1981	M	19	30.1	1.1	0.6 – 1.7
		F	7	11.1	1.2	0.5 – 2.5
		B	26	20.5	1.1	0.7 – 1.6
	1982-1987	M	14	18.4	0.6	0.3 – 1.0
		F	8	10.3	0.8	0.3 – 1.6
		B	22	14.3	0.7	0.4 – 1.0
	1988-1993	M	17	19.4	0.7	0.4 – 1.1
		F	11	11.9	0.8	0.4 – 1.5
		B	28	15.7	0.7	0.5 – 1.1
	1994-1999	M	25	24.4	0.9	0.6 – 1.4
		F	14	13.0	0.7	0.4 – 1.2
		B	39	18.7	0.8	0.6 – 1.2
	2000-2005	M	24	20.2	0.8	0.5 – 1.2
		F	14	11.3	0.7	0.4 – 1.1
		B	38	15.7	0.8	0.5 – 1.0
	2006-2011	M	18	13.2	0.6	0.3 – 0.9
		F	27	19.5	1.0	0.7 – 1.5
		B	45	16.4	0.8	0.6 - 1.0

Table 1 (continued). Analysis of the incidence of primary cancer diagnoses among study area residents between 1976 and 2011 reported to the Utah Cancer Registry by site code. The total number of cases is 3,469. Case counts "≤3" means the count could be 0 to 3. Case counts ">3" means the case count was large enough to evaluate but is suppressed. Rates are indirect age-standardized incidence rates per 100,000 person-years. The SIRs are the standardized incidence ratios (SIR) with Byar's 95% confidence intervals (CI). Due to rounding, a lower confidence limit of 1.0 may or may not be significant. Significance is indicated by an "S." Sex code is "M" for male, "F" for female, and "B" for both.

Cancer Site	Analytical Period	Sex	Case Count	Rate	SIR	95% CI
14 Other respiratory system	1976-1981	M	≤3			
		F	≤3			
		B	≤3			
	1982-1987	M	≤3			
		F	≤3			
		B	≤3			
	1988-1993	M	≤3			
		F	≤3			
		B	>3	2.3	1.8	0.5 – 4.7
	1994-1999	M	≤3			
		F	≤3			
		B	>3	2.0	1.7	0.4 – 4.3
	2000-2005	M	≤3			
		F	≤3			
		B	≤3			
	2006-2011	M	≤3			
		F	≤3			
		B	>3	1.5	1.2	0.3 – 3.1

Table 1 (continued). Analysis of the incidence of primary cancer diagnoses among study area residents between 1976 and 2011 reported to the Utah Cancer Registry by site code. The total number of cases is 3,469. Case counts "≤3" means the count could be 0 to 3. Case counts ">3" means the case count was large enough to evaluate but is suppressed. Rates are indirect age-standardized incidence rates per 100,000 person-years. The SIRs are the standardized incidence ratios (SIR) with Byar's 95% confidence intervals (CI). Due to rounding, a lower confidence limit of 1.0 may or may not be significant. Significance is indicated by an "S." Sex code is "M" for male, "F" for female, and "B" for both.

Cancer Site	Analytical Period	Sex	Case Count	Rate	SIR	95% CI
15 Bones and joints	1976-1981	M	≤3			
		F	≤3			
		B	≤3			
	1982-1987	M	≤3			
		F	≤3			
		B	≤3			
	1988-1993	M	≤3			
		F	≤3			
		B	≤3			
	1994-1999	M	≤3			
		F	≤3			
		B	≤3			
	2000-2005	M	≤3			
		F	≤3			
		B	≤3			
	2006-2011	M	>3	5.3	3.6	1.5 – 7.5 **S**
		F	≤3			
		B	9	3.4	3.0	1.4 – 5.7 **S**

Table 1 (continued). Analysis of the incidence of primary cancer diagnoses among study area residents between 1976 and 2011 reported to the Utah Cancer Registry by site code. The total number of cases is 3,469. Case counts "≤3" means the count could be 0 to 3. Case counts ">3" means the case count was large enough to evaluate but is suppressed. Rates are indirect age-standardized incidence rates per 100,000 person-years. The SIRs are the standardized incidence ratios (SIR) with Byar's 95% confidence intervals (CI). Due to rounding, a lower confidence limit of 1.0 may or may not be significant. Significance is indicated by an "S." Sex code is "M" for male, "F" for female, and "B" for both.

Cancer Site	Analytical Period	Sex	Case Count	Rate	SIR	95% CI
16 Soft tissue (including heart)	1976-1981	M	≤3			
		F	≤3			
		B	>3	3.5	2.3	0.7 – 5.3
	1982-1987	M	>3	5.0	2.5	0.7 – 6.5
		F	≤3			
		B	>3	3.1	1.7	0.5 – 3.9
	1988-1993	M	>3	5.7	3.0	1.0 – 7.1
		F	≤3			
		B	7	3.9	2.2	0.9 – 4.5
	1994-1999	M	≤3			
		F	>3	5.9	2.6	0.9 – 5.6
		B	9	4.5	1.6	0.8 – 3.1
	2000-2005	M	5	4.4	1.6	0.5 – 3.7
		F	4	3.4	1.5	0.4 – 3.9
		B	9	3.9	1.6	0.7 – 3.0
	2006-2011	M	>3	3.0	0.9	0.2 – 2.2
		F	≤3			
		B	7	2.6	0.8	0.3 – 1.7

Table 1 (continued). Analysis of the incidence of primary cancer diagnoses among study area residents between 1976 and 2011 reported to the Utah Cancer Registry by site code. The total number of cases is 3,469. Case counts "≤3" means the count could be 0 to 3. Case counts ">3" means the case count was large enough to evaluate but is suppressed. Rates are indirect age-standardized incidence rates per 100,000 person-years. The SIRs are the standardized incidence ratios (SIR) with Byar's 95% confidence intervals (CI). Due to rounding, a lower confidence limit of 1.0 may or may not be significant. Significance is indicated by an "S." Sex code is "M" for male, "F" for female, and "B" for both.

Cancer Site	Analytical Period	Sex	Case Count	Rate	SIR	95% CI
17 Cutaneous melanoma	1976-1981	M	6	8.4	1.1	0.4 – 2.4
		F	10	13.9	1.7	0.8 – 3.1
		B	16	11.2	1.4	0.8 – 2.3
	1982-1987	M	12	14.9	1.3	0.7 – 2.2
		F	4	4.8	0.4	0.1 – 1.1
		B	16	9.8	0.8	0.5 – 1.4
	1988-1993	M	15	17.0	1.3	0.7 – 2.2
		F	13	14.2	1.2	0.6 – 2.1
		B	28	15.6	1.3	0.8 – 1.8
	1994-1999	M	27	27.1	1.7	1.1 – 2.4 **S**
		F	14	13.6	1.0	0.6 – 1.8
		B	41	20.3	1.4	1.0 – 1.9
	2000-2005	M	21	18.2	0.9	0.6 – 1.4
		F	26	22.2	1.4	0.9 – 2.0
		B	47	20.3	1.1	0.8 – 1.5
	2006-2011	M	57	42.3	1.4	1.1 – 1.9 **S**
		F	35	25.7	1.3	0.9 – 1.8
		B	92	34.1	1.4	1.1 – 1.7 **S**

Table 1 (continued). Analysis of the incidence of primary cancer diagnoses among study area residents between 1976 and 2011 reported to the Utah Cancer Registry by site code. The total number of cases is 3,469. Case counts "≤3" means the count could be 0 to 3. Case counts ">3" means the case count was large enough to evaluate but is suppressed. Rates are indirect age-standardized incidence rates per 100,000 person-years. The SIRs are the standardized incidence ratios (SIR) with Byar's 95% confidence intervals (CI). Due to rounding, a lower confidence limit of 1.0 may or may not be significant. Significance is indicated by an "S." Sex code is "M" for male, "F" for female, and "B" for both.

Cancer Site	Analytical Period	Sex	Case Count	Rate	SIR	95% CI
18 Other non-melanoma skin cancers	1976-1981	M	≤3			
		F	≤3			
		B	≤3			
	1982-1987	M	≤3			
		F	≤3			
		B	≤3			
	1988-1993	M	≤3			
		F	≤3			
		B	≤3			
	1994-1999	M	≤3			
		F	≤3			
		B	≤3			
	2000-2005	M	≤3			
		F	≤3			
		B	≤3			
	2006-2011	M	>3	3.7	1.5	0.5 – 3.4
		F	≤3			
		B	>3	2.2	1.1	0.4 – 2.3

Table 1 (continued). Analysis of the incidence of primary cancer diagnoses among study area residents between 1976 and 2011 reported to the Utah Cancer Registry by site code. The total number of cases is 3,469. Case counts "≤3" means the count could be 0 to 3. Case counts ">3" means the case count was large enough to evaluate but is suppressed. Rates are indirect age-standardized incidence rates per 100,000 person-years. The SIRs are the standardized incidence ratios (SIR) with Byar's 95% confidence intervals (CI). Due to rounding, a lower confidence limit of 1.0 may or may not be significant. Significance is indicated by an "S." Sex code is "M" for male, "F" for female, and "B" for both.

Cancer Site	Analytical Period	Sex	Case Count	Rate	SIR	95% CI
19 Breast	1976-1981	F	44	66.6	1.1	0.8 – 1.5
	1982-1987	F	62	77.1	1.0	0.8 – 1.3
	1988-1993	F	83	89.6	1.1	0.9 – 1.3
	1994-1999	F	89	83.7	0.9	0.8 – 1.2
	2000-2005	F	130	107.7	1.2	1.0 – 1.4 **S**
	2006-2011	F	150	109.9	1.2	1.0 – 1.4 **S**

Table 1 (continued). Analysis of the incidence of primary cancer diagnoses among study area residents between 1976 and 2011 reported to the Utah Cancer Registry by site code. The total number of cases is 3,469. Case counts "≤3" means the count could be 0 to 3. Case counts ">3" means the case count was large enough to evaluate but is suppressed. Rates are indirect age-standardized incidence rates per 100,000 person-years. The SIRs are the standardized incidence ratios (SIR) with Byar's 95% confidence intervals (CI). Due to rounding, a lower confidence limit of 1.0 may or may not be significant. Significance is indicated by an "S." Sex code is "M" for male, "F" for female, and "B" for both.

Cancer Site	Analytical Period	Sex	Case Count	Rate	SIR	95% CI
20 Cervix	1976-1981	F	≤3			
	1982-1987	F	≤3			
	1988-1993	F	9	9.7	1.2	0.6 – 2.3
	1994-1999	F	≤3			
	2000-2005	F	≤3			
	2006-2011	F	≤3			

Table 1 (continued). Analysis of the incidence of primary cancer diagnoses among study area residents between 1976 and 2011 reported to the Utah Cancer Registry by site code. The total number of cases is 3,469. Case counts "≤3" means the count could be 0 to 3. Case counts ">3" means the case count was large enough to evaluate but is suppressed. Rates are indirect age-standardized incidence rates per 100,000 person-years. The SIRs are the standardized incidence ratios (SIR) with Byar's 95% confidence intervals (CI). Due to rounding, a lower confidence limit of 1.0 may or may not be significant. Significance is indicated by an "S." Sex code is "M" for male, "F" for female, and "B" for both.

Cancer Site	Analytical Period	Sex	Case Count	Rate	SIR	95% CI
21 Uterus	1976-1981	F	14	21.7	1.0	0.6 – 1.7
	1982-1987	F	21	26.5	1.4	0.9 – 2.2
	1988-1993	F	23	24.5	1.3	0.8 – 1.9
	1994-1999	F	20	18.7	1.0	0.6 – 1.6
	2000-2005	F	17	14.0	0.8	0.5 – 1.3
	2006-2011	F	35	25.8	1.2	0.9 – 1.7

Table 1 (continued). Analysis of the incidence of primary cancer diagnoses among study area residents between 1976 and 2011 reported to the Utah Cancer Registry by site code. The total number of cases is 3,469. Case counts "≤3" means the count could be 0 to 3. Case counts ">3" means the case count was large enough to evaluate but is suppressed. Rates are indirect age-standardized incidence rates per 100,000 person-years. The SIRs are the standardized incidence ratios (SIR) with Byar's 95% confidence intervals (CI). Due to rounding, a lower confidence limit of 1.0 may or may not be significant. Significance is indicated by an "S." Sex code is "M" for male, "F" for female, and "B" for both.

Cancer Site	Analytical Period	Sex	Case Count	Rate	SIR	95% CI
22 Ovary	1976-1981	F	4	6.1	0.5	0.1 – 1.4
	1982-1987	F	9	11.2	1.0	0.5 – 1.9
	1988-1993	F	4	4.3	0.4	0.1 – 1.0
	1994-1999	F	17	16.0	1.5	0.9 – 2.4
	2000-2005	F	6	5.0	0.5	0.2 – 1.0
	2006-2011	F	9	6.6	0.7	0.3 – 1.3

Table 1 (continued). Analysis of the incidence of primary cancer diagnoses among study area residents between 1976 and 2011 reported to the Utah Cancer Registry by site code. The total number of cases is 3,469. Case counts "≤3" means the count could be 0 to 3. Case counts ">3" means the case count was large enough to evaluate but is suppressed. Rates are indirect age-standardized incidence rates per 100,000 person-years. The SIRs are the standardized incidence ratios (SIR) with Byar's 95% confidence intervals (CI). Due to rounding, a lower confidence limit of 1.0 may or may not be significant. Significance is indicated by an "S." Sex code is "M" for male, "F" for female, and "B" for both.

Cancer Site	Analytical Period	Sex	Case Count	Rate	SIR	95% CI
23 Other female genital	1976-1981	F	≤3			
	1982-1987	F	≤3			
	1988-1993	F	≤3			
	1994-1999	F	≤3			
	2000-2005	F	≤3			
	2006-2011	F	≤3			

Table 1 (continued). Analysis of the incidence of primary cancer diagnoses among study area residents between 1976 and 2011 reported to the Utah Cancer Registry by site code. The total number of cases is 3,469. Case counts "≤3" means the count could be 0 to 3. Case counts ">3" means the case count was large enough to evaluate but is suppressed. Rates are indirect age-standardized incidence rates per 100,000 person-years. The SIRs are the standardized incidence ratios (SIR) with Byar's 95% confidence intervals (CI). Due to rounding, a lower confidence limit of 1.0 may or may not be significant. Significance is indicated by an "S." Sex code is "M" for male, "F" for female, and "B" for both.

Cancer Site	Analytical Period	Sex	Case Count	Rate	SIR	95% CI
24 Prostate	1976-1981	M	37	65.3	1.1	0.8 – 1.5
	1982-1987	M	51	70.6	1.0	0.7 – 1.3
	1988-1993	M	126	146.4	1.2	1.0 – 1.5 **S**
	1994-1999	M	147	142.9	1.3	1.1 – 1.6 **S**
	2000-2005	M	146	123.0	1.1	0.9 – 1.2
	2006-2011	M	193	143.2	1.2	1.0 – 1.4 **S**

Table 1 (continued). Analysis of the incidence of primary cancer diagnoses among study area residents between 1976 and 2011 reported to the Utah Cancer Registry by site code. The total number of cases is 3,469. Case counts "≤3" means the count could be 0 to 3. Case counts ">3" means the case count was large enough to evaluate but is suppressed. Rates are indirect age-standardized incidence rates per 100,000 person-years. The SIRs are the standardized incidence ratios (SIR) with Byar's 95% confidence intervals (CI). Due to rounding, a lower confidence limit of 1.0 may or may not be significant. Significance is indicated by an "S." Sex code is "M" for male, "F" for female, and "B" for both.

Cancer Site	Analytical Period	Sex	Case Count	Rate	SIR	95% CI
25 Testis	1976-1981	M	6	8.2	2.1	0.8 – 4.5
	1982-1987	M	4	5.0	1.0	0.3 – 2.6
	1988-1993	M	7	8.2	1.4	0.6 – 2.9
	1994-1999	M	8	8.6	1.5	0.7 – 3.0
	2000-2005	M	7	6.5	0.9	0.4 – 1.9
	2006-2011	M	6	4.6	0.7	0.2 – 1.4

Table 1 (continued). Analysis of the incidence of primary cancer diagnoses among study area residents between 1976 and 2011 reported to the Utah Cancer Registry by site code. The total number of cases is 3,469. Case counts "≤3" means the count could be 0 to 3. Case counts ">3" means the case count was large enough to evaluate but is suppressed. Rates are indirect age-standardized incidence rates per 100,000 person-years. The SIRs are the standardized incidence ratios (SIR) with Byar's 95% confidence intervals (CI). Due to rounding, a lower confidence limit of 1.0 may or may not be significant. Significance is indicated by an "S." Sex code is "M" for male, "F" for female, and "B" for both.

Cancer Site	Analytical Period	Sex	Case Count	Rate	SIR	95% CI
26 Other male genital	1976-1981	M	≤3			
	1982-1987	M	≤3			
	1988-1993	M	≤3			
	1994-1999	M	≤3			
	2000-2005	M	≤3			
	2006-2011	M	≤3			

Table 1 (continued). Analysis of the incidence of primary cancer diagnoses among study area residents between 1976 and 2011 reported to the Utah Cancer Registry by site code. The total number of cases is 3,469. Case counts "≤3" means the count could be 0 to 3. Case counts ">3" means the case count was large enough to evaluate but is suppressed. Rates are indirect age-standardized incidence rates per 100,000 person-years. The SIRs are the standardized incidence ratios (SIR) with Byar's 95% confidence intervals (CI). Due to rounding, a lower confidence limit of 1.0 may or may not be significant. Significance is indicated by an "S." Sex code is "M" for male, "F" for female, and "B" for both.

Cancer Site	Analytical Period	Sex	Case Count	Rate	SIR	95% CI
27 Bladder	1976-1981	M	11	17.9	1.2	0.6 – 2.1
		F	5	9.0	1.8	0.6 – 4.3
		B	16	13.3	1.3	0.8 – 2.2
	1982-1987	M	>3	13.3	1.1	0.5 – 2.1
		F	≤3			
		B	11	7.3	1.0	0.5 – 1.8
	1988-1993	M	>3	10.4	1.0	0.5 – 1.9
		F	≤3			
		B	12	6.9	1.0	0.5 – 1.8
	1994-1999	M	>3	13.7	1.3	0.7 – 2.2
		F	≤3			
		B	16	7.7	1.1	0.6 – 1.8
	2000-2005	M	13	10.9	1.2	0.7 – 2.1
		F	4	3.2	1.3	0.3 – 3.2
		B	17	7.1	1.2	0.7 – 2.0
	2006-2011	M	15	10.9	1.1	0.6 – 1.9
		F	7	5.0	2.2	0.9 – 4.5
		B	22	8.0	1.3	0.8 – 2.0

Table 1 (continued). Analysis of the incidence of primary cancer diagnoses among study area residents between 1976 and 2011 reported to the Utah Cancer Registry by site code. The total number of cases is 3,469. Case counts "≤3" means the count could be 0 to 3. Case counts ">3" means the case count was large enough to evaluate but is suppressed. Rates are indirect age-standardized incidence rates per 100,000 person-years. The SIRs are the standardized incidence ratios (SIR) with Byar's 95% confidence intervals (CI). Due to rounding, a lower confidence limit of 1.0 may or may not be significant. Significance is indicated by an "S." Sex code is "M" for male, "F" for female, and "B" for both.

Cancer Site	Analytical Period	Sex	Case Count	Rate	SIR	95% CI
28 Kidney and renal pelvis	1976-1981	M	≤3			
		F	>3	6.2	2.0	0.5 – 5.1
		B	>3	4.5	1.1	0.4 – 2.4
	1982-1987	M	>3	6.4	1.1	0.4 – 2.7
		F	≤3			
		B	>3	3.2	0.7	0.2 – 1.6
	1988-1993	M	≤3			
		F	≤3			
		B	>3	2.8	0.5	0.2 – 1.2
	1994-1999	M	7	6.9	1.0	0.4 – 2.0
		F	5	4.7	1.1	0.3 – 2.5
		B	12	5.8	1.0	0.5 – 1.8
	2000-2005	M	6	5.1	0.6	0.2 – 1.2
		F	5	4.1	0.6	0.2 – 1.5
		B	11	4.6	0.6	0.3 – 1.1
	2006-2011	M	19	14.2	1.3	0.8 – 2.0
		F	17	12.4	1.6	0.9 – 2.6
		B	36	13.4	1.4	1.0 – 1.9

Table 1 (continued). Analysis of the incidence of primary cancer diagnoses among study area residents between 1976 and 2011 reported to the Utah Cancer Registry by site code. The total number of cases is 3,469. Case counts "≤3" means the count could be 0 to 3. Case counts ">3" means the case count was large enough to evaluate but is suppressed. Rates are indirect age-standardized incidence rates per 100,000 person-years. The SIRs are the standardized incidence ratios (SIR) with Byar's 95% confidence intervals (CI). Due to rounding, a lower confidence limit of 1.0 may or may not be significant. Significance is indicated by an "S." Sex code is "M" for male, "F" for female, and "B" for both.

Cancer Site	Analytical Period	Sex	Case Count	Rate	SIR	95% CI
29 Other urinary	1976-1981	M	≤3			
		F	≤3			
		B	≤3			
	1982-1987	M	≤3			
		F	≤3			
		B	≤3			
	1988-1993	M	≤3			
		F	≤3			
		B	≤3			
	1994-1999	M	≤3			
		F	≤3			
		B	≤3			
	2000-2005	M	≤3			
		F	≤3			
		B	≤3			
	2006-2011	M	≤3			
		F	≤3			
		B	≤3			

Table 1 (continued). Analysis of the incidence of primary cancer diagnoses among study area residents between 1976 and 2011 reported to the Utah Cancer Registry by site code. The total number of cases is 3,469. Case counts "≤3" means the count could be 0 to 3. Case counts ">3" means the case count was large enough to evaluate but is suppressed. Rates are indirect age-standardized incidence rates per 100,000 person-years. The SIRs are the standardized incidence ratios (SIR) with Byar's 95% confidence intervals (CI). Due to rounding, a lower confidence limit of 1.0 may or may not be significant. Significance is indicated by an "S." Sex code is "M" for male, "F" for female, and "B" for both.

Cancer Site	Analytical Period	Sex	Case Count	Rate	SIR	95% CI
30 Eye and orbit	1976-1981	M	≤3			
		F	≤3			
		B	≤3			
	1982-1987	M	≤3			
		F	≤3			
		B	≤3			
	1988-1993	M	≤3			
		F	≤3			
		B	≤3			
	1994-1999	M	≤3			
		F	≤3			
		B	≤3			
	2000-2005	M	≤3			
		F	≤3			
		B	≤3			
	2006-2011	M	≤3			
		F	≤3			
		B	≤3			

Table 1 (continued). Analysis of the incidence of primary cancer diagnoses among study area residents between 1976 and 2011 reported to the Utah Cancer Registry by site code. The total number of cases is 3,469. Case counts "≤3" means the count could be 0 to 3. Case counts ">3" means the case count was large enough to evaluate but is suppressed. Rates are indirect age-standardized incidence rates per 100,000 person-years. The SIRs are the standardized incidence ratios (SIR) with Byar's 95% confidence intervals (CI). Due to rounding, a lower confidence limit of 1.0 may or may not be significant. Significance is indicated by an "S." Sex code is "M" for male, "F" for female, and "B" for both.

Cancer Site	Analytical Period	Sex	Case Count	Rate	SIR	95% CI
31 Brain	1976-1981	M	≤3			
		F	>3	8.5	2.0	0.7 – 4.4
		B	8	5.6	1.2	0.5 – 2.4
	1982-1987	M	>3	4.9	0.9	0.2 – 2.2
		F	≤3			
		B	7	4.3	0.8	0.3 – 1.7
	1988-1993	M	4	4.5	0.7	0.2 – 1.9
		F	6	6.5	1.3	0.5 – 2.7
		B	10	5.6	1.0	0.5 – 1.8
	1994-1999	M	7	7.1	1.2	0.5 – 2.4
		F	12	11.7	2.4	1.2 – 4.2 **S**
		B	19	9.5	1.7	1.0 – 2.7 **S**
	2000-2005	M	9	7.9	1.3	0.6 – 2.4
		F	7	6.1	1.2	0.5 – 2.5
		B	16	7.0	1.2	0.7 – 2.0
	2006-2011	M	12	9.0	1.3	0.7 – 2.3
		F	6	4.4	0.9	0.3 – 1.9
		B	18	6.7	1.1	0.7 – 1.8

Table 1 (continued). Analysis of the incidence of primary cancer diagnoses among study area residents between 1976 and 2011 reported to the Utah Cancer Registry by site code. The total number of cases is 3,469. Case counts "≤3" means the count could be 0 to 3. Case counts ">3" means the case count was large enough to evaluate but is suppressed. Rates are indirect age-standardized incidence rates per 100,000 person-years. The SIRs are the standardized incidence ratios (SIR) with Byar's 95% confidence intervals (CI). Due to rounding, a lower confidence limit of 1.0 may or may not be significant. Significance is indicated by an "S." Sex code is "M" for male, "F" for female, and "B" for both.

Cancer Site	Analytical Period	Sex	Case Count	Rate	SIR	95% CI
32 Other central nervous system	1976-1981	M	≤3			
		F	≤3			
		B	≤3			
	1982-1987	M	≤3			
		F	≤3			
		B	≤3			
	1988-1993	M	≤3			
		F	≤3			
		B	≤3			
	1994-1999	M	≤3			
		F	≤3			
		B	≤3			
	2000-2005	M	≤3			
		F	≤3			
		B	≤3			
	2006-2011	M	≤3			
		F	≤3			
		B	≤3			

Table 1 (continued). Analysis of the incidence of primary cancer diagnoses among study area residents between 1976 and 2011 reported to the Utah Cancer Registry by site code. The total number of cases is 3,469. Case counts "≤3" means the count could be 0 to 3. Case counts ">3" means the case count was large enough to evaluate but is suppressed. Rates are indirect age-standardized incidence rates per 100,000 person-years. The SIRs are the standardized incidence ratios (SIR) with Byar's 95% confidence intervals (CI). Due to rounding, a lower confidence limit of 1.0 may or may not be significant. Significance is indicated by an "S." Sex code is "M" for male, "F" for female, and "B" for both.

Cancer Site	Analytical Period	Sex	Case Count	Rate	SIR	95% CI
33 Thyroid	1976-1981	M	4	5.4	3.1	0.8 – 7.8
		F	4	5.4	0.9	0.2 – 2.3
		B	8	5.4	1.4	0.6 – 2.8
	1982-1987	M	≤3			
		F	>3	4.8	0.7	0.2 – 1.8
		B	7	4.2	1.0	0.4 – 2.0
	1988-1993	M	5	5.7	2.0	0.7 – 4.7
		F	5	5.4	0.7	0.2 – 1.6
		B	10	5.5	1.0	0.5 – 1.9
	1994-1999	M	≤3			
		F	>3	9.0	0.9	0.4 – 1.7
		B	10	5.0	0.8	0.4 – 1.4
	2000-2005	M	4	3.5	0.8	0.2 – 2.0
		F	10	8.8	0.6	0.3 – 1.1
		B	14	6.1	0.6	0.3 – 1.1
	2006-2011	M	6	4.6	0.7	0.3 – 1.6
		F	34	25.2	1.1	0.8 – 1.6
		B	40	14.9	1.0	0.7 – 1.4

Table 1 (continued). Analysis of the incidence of primary cancer diagnoses among study area residents between 1976 and 2011 reported to the Utah Cancer Registry by site code. The total number of cases is 3,469. Case counts "≤3" means the count could be 0 to 3. Case counts ">3" means the case count was large enough to evaluate but is suppressed. Rates are indirect age-standardized incidence rates per 100,000 person-years. The SIRs are the standardized incidence ratios (SIR) with Byar's 95% confidence intervals (CI). Due to rounding, a lower confidence limit of 1.0 may or may not be significant. Significance is indicated by an "S." Sex code is "M" for male, "F" for female, and "B" for both.

Cancer Site	Analytical Period	Sex	Case Count	Rate	SIR	95% CI
34 Other endocrine	1976-1981	M	≤3			
		F	≤3			
		B	≤3			
	1982-1987	M	≤3			
		F	≤3			
		B	≤3			
	1988-1993	M	≤3			
		F	≤3			
		B	≤3			
	1994-1999	M	≤3			
		F	≤3			
		B	≤3			
	2000-2005	M	≤3			
		F	≤3			
		B	≤3			
	2006-2011	M	≤3			
		F	≤3			
		B	≤3			

Table 1 (continued). Analysis of the incidence of primary cancer diagnoses among study area residents between 1976 and 2011 reported to the Utah Cancer Registry by site code. The total number of cases is 3,469. Case counts "≤3" means the count could be 0 to 3. Case counts ">3" means the case count was large enough to evaluate but is suppressed. Rates are indirect age-standardized incidence rates per 100,000 person-years. The SIRs are the standardized incidence ratios (SIR) with Byar's 95% confidence intervals (CI). Due to rounding, a lower confidence limit of 1.0 may or may not be significant. Significance is indicated by an "S." Sex code is "M" for male, "F" for female, and "B" for both.

Cancer Site	Analytical Period	Sex	Case Count	Rate	SIR	95% CI
35 Hodgkin lymphoma	1976-1981	M	≤3			
		F	≤3			
		B	>3	4.2	1.7	0.6 – 3.7
	1982-1987	M	≤3			
		F	≤3			
		B	≤3			
	1988-1993	M	≤3			
		F	>3	4.4	2.0	0.5 – 5.2
		B	>3	3.4	1.6	0.6 – 3.4
	1994-1999	M	≤3			
		F	>3	4.1	2.0	0.5 – 5.0
		B	7	3.7	1.5	0.6 – 3.2
	2000-2005	M	≤3			
		F	>3	3.6	1.7	0.4 – 4.3
		B	>3	2.2	1.0	0.3 – 2.4
	2006-2011	M	5	3.8	1.3	0.4 – 3.0
		F	4	3.0	1.3	0.4 – 3.4
		B	9	3.4	1.3	0.6 – 2.5

Table 1 (continued). Analysis of the incidence of primary cancer diagnoses among study area residents between 1976 and 2011 reported to the Utah Cancer Registry by site code. The total number of cases is 3,469. Case counts "≤3" means the count could be 0 to 3. Case counts ">3" means the case count was large enough to evaluate but is suppressed. Rates are indirect age-standardized incidence rates per 100,000 person-years. The SIRs are the standardized incidence ratios (SIR) with Byar's 95% confidence intervals (CI). Due to rounding, a lower confidence limit of 1.0 may or may not be significant. Significance is indicated by an "S." Sex code is "M" for male, "F" for female, and "B" for both.

Cancer Site	Analytical Period	Sex	Case Count	Rate	SIR	95% CI
36 Non-Hodgkin lymphoma	1976-1981	M	5	7.5	0.9	0.3 – 2.2
		F	5	8.2	1.1	0.3 – 2.5
		B	10	7.8	1.0	0.5 – 1.8
	1982-1987	M	7	9.1	0.9	0.4 – 1.9
		F	6	7.9	1.0	0.4 – 2.1
		B	13	8.5	1.0	0.5 – 1.6
	1988-1993	M	13	14.9	1.2	0.6 – 2.0
		F	8	8.8	0.8	0.3 – 1.6
		B	21	11.8	1.0	0.6 – 1.5
	1994-1999	M	9	8.9	0.6	0.3 – 1.2
		F	15	14.1	1.3	0.7 – 2.1
		B	24	11.6	0.9	0.6 – 1.3
	2000-2005	M	20	17.2	1.1	0.7 – 1.7
		F	17	13.9	1.1	0.7 – 1.8
		B	37	15.6	1.1	0.8 – 1.5
	2006-2011	M	31	23.0	1.3	0.9 – 1.9
		F	17	12.3	0.9	0.5 – 1.5
		B	48	17.6	1.2	0.9 – 1.5

Table 1 (continued). Analysis of the incidence of primary cancer diagnoses among study area residents between 1976 and 2011 reported to the Utah Cancer Registry by site code. The total number of cases is 3,469. Case counts "≤3" means the count could be 0 to 3. Case counts ">3" means the case count was large enough to evaluate but is suppressed. Rates are indirect age-standardized incidence rates per 100,000 person-years. The SIRs are the standardized incidence ratios (SIR) with Byar's 95% confidence intervals (CI). Due to rounding, a lower confidence limit of 1.0 may or may not be significant. Significance is indicated by an "S." Sex code is "M" for male, "F" for female, and "B" for both.

Cancer Site	Analytical Period	Sex	Case Count	Rate	SIR	95% CI
37 Multiple myeloma	1976-1981	M	≤3			
		F	≤3			
		B	≤3			
	1982-1987	M	≤3			
		F	≤3			
		B	>3	4.0	1.3	0.5 – 2.8
	1988-1993	M	≤3			
		F	>3	4.5	1.6	0.4 – 4.0
		B	7	4.0	1.2	0.5 – 2.5
	1994-1999	M	>3	3.9	0.9	0.2 – 2.2
		F	≤3			
		B	>3	2.9	0.8	0.3 – 1.7
	2000-2005	M	≤3			
		F	>3	4.0	1.2	0.4 – 2.9
		B	8	3.3	0.9	0.4 – 1.7
	2006-2011	M	6	4.4	0.9	0.3 – 1.9
		F	5	3.6	1.0	0.3 – 2.4
		B	11	4.0	0.9	0.5 – 1.7

Table 1 (continued). Analysis of the incidence of primary cancer diagnoses among study area residents between 1976 and 2011 reported to the Utah Cancer Registry by site code. The total number of cases is 3,469. Case counts "≤3" means the count could be 0 to 3. Case counts ">3" means the case count was large enough to evaluate but is suppressed. Rates are indirect age-standardized incidence rates per 100,000 person-years. The SIRs are the standardized incidence ratios (SIR) with Byar's 95% confidence intervals (CI). Due to rounding, a lower confidence limit of 1.0 may or may not be significant. Significance is indicated by an "S." Sex code is "M" for male, "F" for female, and "B" for both.

Cancer Site	Analytical Period	Sex	Case Count	Rate	SIR	95% CI
38 Lymphocytic leukemia	1976-1981	M	≤3			
		F	>3	9.1	2.4	0.9 – 5.3
		B	8	6.0	1.3	0.6 – 2.7
	1982-1987	M	>3	7.6	1.4	0.5 – 3.0
		F	≤3			
		B	9	5.7	1.3	0.6 – 2.4
	1988-1993	M	5	5.7	1.1	0.4 – 2.5
		F	4	4.4	1.2	0.3 – 3.1
		B	9	5.1	1.1	0.5 – 2.2
	1994-1999	M	6	6.0	1.2	0.4 – 2.5
		F	6	5.8	1.8	0.7 – 3.9
		B	12	5.9	1.4	0.7 – 2.5
	2000-2005	M	7	6.0	1.0	0.4 – 2.0
		F	5	4.2	1.0	0.3 – 2.2
		B	12	5.1	1.0	0.5 – 1.7
	2006-2011	M	9	6.6	1.0	0.5 – 1.9
		F	5	3.6	0.8	0.3 – 2.0
		B	14	5.1	1.0	0.5 – 1.6

Table 1 (continued). Analysis of the incidence of primary cancer diagnoses among study area residents between 1976 and 2011 reported to the Utah Cancer Registry by site code. The total number of cases is 3,469. Case counts "≤3" means the count could be 0 to 3. Case counts ">3" means the case count was large enough to evaluate but is suppressed. Rates are indirect age-standardized incidence rates per 100,000 person-years. The SIRs are the standardized incidence ratios (SIR) with Byar's 95% confidence intervals (CI). Due to rounding, a lower confidence limit of 1.0 may or may not be significant. Significance is indicated by an "S." Sex code is "M" for male, "F" for female, and "B" for both.

Cancer Site	Analytical Period	Sex	Case Count	Rate	SIR	95% CI
39 Myeloid leukemia	1976-1981	M	≤3			
		F	≤3			
		B	>3	3.8	1.2	0.4 – 2.9
	1982-1987	M	≤3			
		F	≤3			
		B	>3	2.6	0.8	0.2 – 2.1
	1988-1993	M	≤3			
		F	≤3			
		B	>3	2.3	0.8	0.2 – 2.0
	1994-1999	M	≤3			
		F	>3	3.8	1.5	0.4 – 3.7
		B	7	3.5	1.0	0.4 – 2.2
	2000-2005	M	≤3			
		F	≤3			
		B	≤3			
	2006-2011	M	4	3.0	0.8	0.2 – 2.0
		F	8	5.8	2.0	0.9 – 4.0
		B	12	4.4	1.3	0.7 – 2.3

Table 1 (continued). Analysis of the incidence of primary cancer diagnoses among study area residents between 1976 and 2011 reported to the Utah Cancer Registry by site code. The total number of cases is 3,469. Case counts "≤3" means the count could be 0 to 3. Case counts ">3" means the case count was large enough to evaluate but is suppressed. Rates are indirect age-standardized incidence rates per 100,000 person-years. The SIRs are the standardized incidence ratios (SIR) with Byar's 95% confidence intervals (CI). Due to rounding, a lower confidence limit of 1.0 may or may not be significant. Significance is indicated by an "S." Sex code is "M" for male, "F" for female, and "B" for both.

Cancer Site	Analytical Period	Sex	Case Count	Rate	SIR	95% CI
40 Monocytic leukemia	1976-1981	M	≤3			
		F	≤3			
		B	≤3			
	1982-1987	M	≤3			
		F	≤3			
		B	≤3			
	1988-1993	M	≤3			
		F	≤3			
		B	≤3			
	1994-1999	M	≤3			
		F	≤3			
		B	≤3			
	2000-2005	M	≤3			
		F	≤3			
		B	≤3			
	2006-2011	M	≤3			
		F	≤3			
		B	≤3			

Table 1 (continued). Analysis of the incidence of primary cancer diagnoses among study area residents between 1976 and 2011 reported to the Utah Cancer Registry by site code. The total number of cases is 3,469. Case counts "≤3" means the count could be 0 to 3. Case counts ">3" means the case count was large enough to evaluate but is suppressed. Rates are indirect age-standardized incidence rates per 100,000 person-years. The SIRs are the standardized incidence ratios (SIR) with Byar's 95% confidence intervals (CI). Due to rounding, a lower confidence limit of 1.0 may or may not be significant. Significance is indicated by an "S." Sex code is "M" for male, "F" for female, and "B" for both.

Cancer Site	Analytical Period	Sex	Case Count	Rate	SIR	95% CI
41 Other leukemia	1976-1981	M	≤3			
		F	≤3			
		B	≤3			
	1982-1987	M	≤3			
		F	≤3			
		B	≤3			
	1988-1993	M	≤3			
		F	≤3			
		B	≤3			
	1994-1999	M	≤3			
		F	≤3			
		B	≤3			
	2000-2005	M	≤3			
		F	≤3			
		B	≤3			
	2006-2011	M	≤3			
		F	≤3			
		B	≤3			

Table 1 (continued). Analysis of the incidence of primary cancer diagnoses among study area residents between 1976 and 2011 reported to the Utah Cancer Registry by site code. The total number of cases is 3,469. Case counts "≤3" means the count could be 0 to 3. Case counts ">3" means the case count was large enough to evaluate but is suppressed. Rates are indirect age-standardized incidence rates per 100,000 person-years. The SIRs are the standardized incidence ratios (SIR) with Byar's 95% confidence intervals (CI). Due to rounding, a lower confidence limit of 1.0 may or may not be significant. Significance is indicated by an "S." Sex code is "M" for male, "F" for female, and "B" for both.

Cancer Site	Analytical Period	Sex	Case Count	Rate	SIR	95% CI
42 Other sites/types	1976-1981	M	>3	8.2	1.3	0.4 – 3.0
		F	≤3			
		B	7	6.1	0.9	0.4 – 1.8
	1982-1987	M	5	6.7	1.2	0.4 – 2.7
		F	5	6.9	1.0	0.3 – 2.4
		B	10	6.8	1.1	0.5 – 2.0
	1988-1993	M	5	5.8	0.9	0.3 – 2.1
		F	4	4.5	0.6	0.2 – 1.6
		B	9	5.2	0.7	0.3 – 1.4
	1994-1999	M	6	5.9	1.1	0.4 – 2.4
		F	8	7.5	1.2	0.5 – 2.4
		B	14	6.7	1.1	0.6 – 1.9
	2000-2005	M	10	8.5	1.1	0.5 – 2.0
		F	12	9.7	1.2	0.6 – 2.1
		B	22	9.1	1.1	0.7 – 1.7
	2006-2011	M	11	8.0	0.9	0.4 – 1.6
		F	14	10.0	1.2	0.6 – 1.9
		B	25	9.0	1.0	0.7 – 1.5

DEFINITIONS

ACS	American Cancer Society. The ACS, first established in 1913, is a nationwide voluntary health organization dedicated to eliminating cancer. The society, headquartered in Atlanta, Georgia, has over 900 offices throughout the United States. ACS funding is used for patient support services, research, prevention, detection and treatment and society operations. For more information see: http://www.cancer.org.
ACS	American Community Survey. The ACS is an ongoing survey that provides annual updates to population and demographic estimates derived from census data. The ACS is operated by the USCB. For more information see: http://www.census.gov/acs/www/.
AGRC	Automated Geographic Reference Center. An agency within the Utah Department of Information Technology responsible for maintaining a repository of geographic information system (GIS) data files and GIS functionality. For more information see: http://gis.utah.gov/.
ArcGIS	A complete desktop GIS software application for producing maps and conducting spatial analysis. This application is developed and distributed by ESRI. The EEP uses version 10. For more information see: http://www.esri.com/software/arcgis.
CDC	Centers for Disease Control and Prevention. A federal agency within the U.S. Department of Health and Human Services responsible for investigating disease trends and causalities, and promoting best disease prevention practices. For more information see: http://www.cdc.gov/.
DCHD	Davis County Health Department. One of the 12 local health departments with public health jurisdiction in Utah. DCHD provides public health services to all residents within Davis County, Utah. For more information see: http://www.co.davis.ut.us/health/ or call (801) 525-5000.
EEP	Environmental Epidemiology Program. A program within the Bureau of Epidemiology, Division of Disease Control and Prevention, UDOH. The EEP was established in 1996 and is responsible for investigating diseases related to the environment. The program has two sections. One section conducts surveillance and data management activities including managing the UEPHTN. The other section conducts health hazards risk assessment, including cancer investigations. The program is staffed by personnel with experience and expertise in environmental epidemiology, environmental sciences, toxicology, statistics, public health informatics and geomatics, and health education. For more information see: http://health.utah.gov/enviroepi/.
ESRI	ESRI is a leading developer and supplier of GIS software and geographically referenced data. ESRI is headquartered in Redlands, California. The EEP uses the

	ArcGIS software application developed by ESRI. For more information see: http://www.esri.com.
GeoLytics	GeoLytics is a commercial vendor of census and demographic data calibrated to the 2000 census boundaries. The EEP has purchased 1970, 1980, 1990, 2000 and 2010 census data from GeoLytics to be the basis for estimating intercensal population counts for each of the 1,481 census block group boundaries in Utah. Population counts are aggregated into 5-year age groups for each sex. For more information see: http://www.geolytics.com.
GIS	Geographic Information Systems. A GIS includes computer software and geographically referenced data. The EEP uses ArcGIS as the computer software, and obtains data from ESRI or AGRC.
ICD-O-3	International Classification of Disease - Oncology, 3rd Edition. The ICD-O-3 is one of a number of internationally established coding standards for coding site (topography) and histology (morphology) of neoplasms (cancers). For more information see: http://www.who.int/classifications/icd/adaptations/oncology/en/.
NAACCR	North American Association of Central Cancer Registries. NAACCR was established in 1987 as a collaborative professional organization for cancer registries, governmental agencies and professional associations that work with cancer registries. All central cancer registries in the United States and Canada are members. The purpose of NAACCR is to promote standards and enhance the quality of cancer registry data. The NAACCR also promotes training, epidemiologic research, public health activities, and patient care improvement policies related to cancer. For more information see: http://www.naaccr.org.
NCI	National Cancer Institute. The NCI is one of the National Institutes of Health and part of the U.S. Department of Health and Human Services. The NCI was established under the National Cancer Act of 1937 and is primarily responsible for conducting surveillance and research about cancer incidence, diagnosis, prevention, treatment, and rehabilitation. The SEER program is operated by the NCI. For more information see: http://www.cancer.gov/.
SAS	SAS (originally from “Statistical Analysis System”) is a globally recognized system of integrated computer software products provided by SAS Institute Inc. The SAS system includes a large variety of data manipulation and statistical analysis processes. The EEP uses the desktop version 9.2. For more information see: http://www.sas.com.
SEER	Surveillance, Epidemiology, and End Results Program. The SEER program is an agency within the NCI that works with state cancer registries to develop and disseminate incidence and mortality statistics about cancer in the United States. The SEER program also establishes standards for the analysis of cancer data and

interpretation of cancer statistics. For more information see: http://seer.cancer.gov/.

UBRFS Utah Behavioral Risk Factors Survey. The UBRFS is an ongoing telephonic survey conducted by the Office of Public Health Assessment, UDOH. This survey collects data about health-related behaviors in the non-institutionalized Utah adult population. For more information, see: http://health.utah.gov/opha/OPHA_BRFSS.htm.

UCR Utah Cancer Registry. The UCR is operated under authority from the UDOH by the University of Utah. The UCR was established in 1966 to be a statewide population-based cancer registry. Utah administrative rule requires the reporting of cancer diagnoses to the UCR. The UCR collaborates with the NCI, SEER and the NAACCR to implement data standards for cancer data. The UCR provides cancer data to the EEP through the UEPHTN. For more information, see: http://ucr.utah.edu/.

UDOH Utah Department of Health. The UDOH is one of the executive agencies within Utah state government. The UDOH strives to improve health in Utah through promoting healthy lifestyles, evidence-based interventions, creating healthy and safe communities, and eliminating health disparities. The EEP is a program within the UDOH. For more information, see: http://health.utah.gov/.

UEPHTN Utah Environmental Public Health Tracking Network. The UEPHTN is a data warehouse that contains health outcomes, environmental, and supporting data. Data from the UCR and population data derived from the USCB is warehoused in the UEPHTN. For more information see: http://epht.health.utah.gov/epht-view/.

USCB U.S. Census Bureau. Officially the “Bureau of the Census,” the USCB is an agency authorized by Federal law within the U.S. Department of Commerce that is charged with preparing and conducting regular surveys and censuses of the U.S. population. In addition to the decennial population survey, the USCB conducts a number of other surveys and has recently implemented the ACS. For more information, see: http://www.census.gov/.

WHO The World Health Organization is an agency of the United Nations that deals with international health concerns and policies. For more information see: http://www.who.int/en/.

Cancer Incidence: The term incidence refers to new cases occurring in a period of time, usually annually. Cancer incidence is the number of new cases that occurred in a year. New cancer cases occur when a diagnosis is made. The 2009 national age-adjusted incidence rate is 4.64 cancer cases per 1,000 population per year. For more information, see: http://www.cancer.gov/statistics/glossary/incidence.

Cancer Prevalence: The term prevalence refers to the number of cases that exist either at a moment in time or during a period of time (e.g., annual, lifetime, etc.). When using this term, the time should be included. The 2009 national lifetime cancer prevalence rate is approximately 414.65 cases of cancer among 1,000 population. Cancer prevalence is the total number of cases that exist. For more information, see: http://www.cancer.gov/statistics/glossary/prevalence.

Cancer Incidence Rate: This is a ratio of the cancer incidence (the number of new cancer diagnoses) over the total population. When computing a multiple year rate, the total population added from each year of the rate period is used to get the rate. For more information, see: http://www.cancer.gov/statistics/glossary/incidence.

Indirect Standardized Incidence Rate: The raw (sometimes called "crude") disease incidence rate (number of case incidences per time period divided by the person-years per period) reflects reality. The raw rate is the simplest and most straightforward summary of the population experience. Interpretation of a disease incidence rate involves a comparison of that rate with some comparison or acceptable rate to determine if the rate in question is high or low. Because rates will almost always involve comparing two populations with two different age distributions, comparison of a raw disease incidence rate with a comparison rate is problematic. It does not make sense to compare the rate of disease of a relatively young population with a relatively older population for a disease that is more common in the elderly; it would not be possible to state with confidence that the disease rate is higher or lower than expected. For this reason, when the objective is to compare two rates, age standardized rates are preferable. However, it should be noted that the rate itself, once standardized, is not the exact disease burden. The standardized rate should be of the same magnitude as the raw rate.

The indirect standardization method is the preferred method when the disease count in each age group is small or zero. A disadvantage of the indirect method is that the rate is comparable to the comparison population used in its computation, but is not comparable to other population rates. For example, for this study, the study area cancer rates are adjusted using the Utah state population and therefore are comparable to the Utah state rates. However, they are not comparable to the county rates or to national rates.

The Indirect Standardized Rate for the study area (ISR_M) is calculated by:

$$ISR_M = \frac{C_M}{\sum_{age}\left(\frac{C_{U,age}}{P_{U,age}} P_{M,age}\right)} \times \left(\frac{C_U}{P_U}\right) \times 100{,}000$$

Where:

ISR_M is the Indirect Standardized Incidence Rate for the study area.

C_M is the total cancer incidence count for the study area for a specific analytical period (e.g., 1990 - 1994).

$C_{U,age}$ is an age-group (e.g., 0 to 19 year in age, etc.) specific cancer incidence count for the state of Utah for a specific analytical period.

$P_{U,age}$ is the age-group specific count of person-years (e.g., number of 0-19 year olds in 1990 plus number of 0-19 year olds in 1991 plus number of 0-19 year olds in 1992 ...) for the state of Utah for a specific analytical period.

$P_{M,age}$ is the age-group specific count of person-years for the study area for a specific analytical period.

C_U is the total cancer incidence count for the state of Utah for a specific analytical period.

P_U is the total count of person-years for the state of Utah for a specific analytical period.

For purposes of presentation, it is standard practice to present rates per a population of 100,000 people. For example, 60 cases per 100,000 people is easier to understand than 0.00006 cases per person.

E_M is the expected case count of cancer incidence for the study area for a specific analytical period. This is the denominator factor of the first term of the rate formula.

$$E_M = \sum_{age}\left(\frac{C_{U,age}}{P_{U,age}} P_{M,age}\right)$$

Standardized Incidence Ratio. The standardized incidence ratio (SIR) is a way of comparing two rates. When using the indirect standardized rate method, the SIR is the first term of the formula to compute the rate.

$$SIR = \frac{C_M}{\sum_{age}\left(\frac{C_{U,age}}{P_{U,age}} P_{M,age}\right)} = \frac{C_M}{E_M}$$

The Byar's 95% confidence limits ($Z_\alpha = 1.96$) can be calculated for the SIR by:

$$\underline{\overline{SIR}} = \frac{(C_M + k)}{E_M} \times \left[1 - \left(\frac{1}{3 \cdot (C_M + k)}\right) + \left(\frac{\pm 1.96}{3 \cdot \sqrt{C_M + k}}\right)\right]^3$$

Where:

SIR is the standardized incidence ratio. The bar over and under means the upper and lower confidence limits of the SIR.

C_M is the total case count of cancer incidence count for the study area for a specific analytical period.

E_M is the expected case count of cancer incidence for the study area for a specific analytical period.

K is a constant for symmetry. For the upper confidence limit, k = 1. For the lower confidence limit, k = 0.

± 1.96 is the normal distribution (Z_α) function for a 95% confidence interval. For the upper confidence interval it is a positive value. For the lower confidence interval it is a negative value.