**CANCER INCIDENCE STUDY**

# Cancer Incidence Statistical Review – Five Year Update For Moab, Grand County, Utah Covering the Period from 1980 to 2014

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## TABLE OF CONTENTS

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## EXECUTIVE SUMMARY

Cancer is a dominating environmental public health concern. A function of the Utah Department of Health (UDOH) Environmental Epidemiology Program (EEP) is to investigate cancer incidence, starting with a statistical review of cancer cases. In 2012, the Southeast Utah Health Department (SEUHD) forwarded a request from the Grand County Council and the mayor of Moab that the EEP conduct a statistical review of cancer incidence in Moab and the surrounding communities. That report was released on April 15, 2013, and recommended a five year update to the initial cancer incidence review. Following that recommendation, SEUHD and the Moab Uranium Mill Tailings Remedial Action (UMTRA) committee requested that the EEP carry out this five year cancer incidence update.

This report presents a statistical review of cancer among residents of the census block groups surrounding Moab. The cancer incidence (i.e., new cases) between 1980 and 2014 in seven sequential five-year time periods for the 42 anatomical site-specific cancer categories was compared to expected counts derived from the state age-adjusted cancer rate for the corresponding site and time period. The EEP considers the cancer rate ratios to be significantly elevated when the 99% confidence limits do not include 1.0, which is the value expected when there is no difference between the study area and state rates. Additional criteria to help identify meaningful results include any final analytical period where the rate ratio is three or more standard errors above 1.0, as this may indicate an emerging cluster.

Lung and bronchial cancer rates were significantly elevated in men for five of the seven analytical periods. The increased risk ranged from 2.0 to 3.3 times higher than expected when compared to rates in the rest of the state. Lung and bronchial cancer rates were also elevated in women during the 1995-1999 period, and in both genders combined in all analytical periods except 2005-2009. These findings suggest the presence of a temporal cluster of lung and bronchial cancer in Moab among men, but do not indicate a cluster among women. Smoking is by far the most important risk factor for lung cancer; other risk factors include respiratory exposure to radon, asbestos, and certain other substances such as uranium, arsenic, and diesel exhaust. Cervical cancer was elevated during the first time period (1980-1984), which may show the end of a historical cluster that ended during the first analytical period, or it may represent a normal fluctuation in the data.

Early detection and intervention of cancer can dramatically improve the prognosis for recovery and quality of life. Because some cancer types have many year latency periods following a triggering event or exposure, the EEP recommends that SEUHD request another follow-up cancer statistical review after an additional five years of data (2015-2019) become available. Further, the EEP recommends that SEUHD work with Utah Department of Health programs such as the Utah Cancer Control Program and the Utah Tobacco Prevention and Control Program for screening and health education services that could be made available to study area residents.

# INTRODUCTION

## Cancer Incidence Statistical Reviews

A core function of epidemiology is to track and evaluate disease patterns. This 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 recognize 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 to public health agencies to conduct investigations.

Public health agencies conduct investigations of cancer incidence using several different methods. The first is a cancer incidence statistical review. This approach 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 data to population data and evaluating trends. From a public health perspective, a cancer incidence statistical review is most useful in identifying community needs about cancer-related health education, building awareness, public health screening services, and other public health interventions. For the community, these kinds of studies empower the residents 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. This method focuses 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. In situations like the one addressed in this report, an extensive exposure assessment would also be important. Data about individual risks are then processed through complex statistical analysis to identify variables that seem to explain the risk (Kingsley et al., 2007). However, cluster investigations rarely result in important discoveries of causality (Goodman et al., 2012; Kingsley et al., 2007).

## Site History

Moab is a rural community in Grand County, Utah of approximately 5,000 permanent residents, located immediately south and east of the Colorado River. Due to its close proximity to Arches National Park, Canyonlands National Park, Dead Horse Point State Park, and a wide variety of other areas popular for outdoor recreation, Moab is a local hub for tourism. For the purposes of this study, Moab includes Spanish Valley, an unincorporated residential area south of the city along State Highway 191.

The Moab uranium mill site is located three miles northwest of the city of Moab and encompasses approximately 480 acres, 130 of which are covered by the tailings pile. U.S. Highway 191 parallels the northern site boundary, and the Colorado River forms the southeastern boundary (**Figure A1**).

In 1956, the Uranium Reduction Company constructed the Moab uranium mill, which began operations that same year. The facility was sold to the Atlas Minerals Corporation in 1962 and was active until 1984. During the period the mill was operational, it processed an average of 1,400 tons of ore per day. The resulting uranium concentrate (commonly known as yellowcake) was sold until 1970 to the U.S. Atomic Energy Commission for use in national defense programs. After 1970, production was primarily focused on commercial sales to nuclear power plants (DOE, 2017).

During its years of operation, the Moab mill generated approximately 16 million tons (or 12 million cubic yards) of mill tailings and tailings-contaminated soil. These tailings were pumped to an unlined impoundment and accumulated over time, eventually forming a pile more than 80 feet thick. Although the milling process removed more than 90% of the uranium from the ore, radium and other radioactive decay products remained in the tailings, which have an average radioactivity of 665 picocuries per gram of radium-226 (DOE, 2017).

Decommissioning activities occurred between 1988 and 1995, during which an interim cover was placed over the tailings pile. In 1998, the Atlas Minerals Corporation declared bankruptcy and relinquished its license. The Nuclear Regulatory Commission appointed a trustee to initiate site reclamation. In 2001, the site was designated a Uranium Mill Tailings Remedial Action (UMTRA) site and the U.S. Department of Energy (DOE) became responsible for remediation. In 2005, DOE published an Environmental Impact Statement documenting its investigation of the site and describing a range of remediation alternatives and their associated environmental effects. Later that year, DOE issued the Record of Decision detailing the selection and rationale for the preferred remediation action. The preferred alternative was to remove the mill tailings and associated contaminated soil to the Crescent Junction disposal site, located 30 miles north of Moab. In 2003, DOE established extraction and injection wells to remediate leakage of ammonia, a mill tailings contaminant, into the river. In 2008 and 2009, DOE constructed the necessary infrastructure to move the tailings to the disposal site; transport of material began in April 2009, primarily via railroad. To date, the project has shipped 8.7 million tons of tailings, or roughly 54% of the total. Estimates of project completion vary between 2025 and 2032 (DOE, 2017; Moab UMTRA, 2017).

**Study Objectives**

This report presents a statistical review of cancer incidence among residents of Moab (including Spanish Valley). The Environmental Epidemiology Program (EEP), within the Utah Department of Health (UDOH), conducted this statistical review by analyzing periodic rates and trends in cancer incidence in the study area, compared to corresponding rates in the remainder of Utah. The objective of a statistical review is to identify significantly elevated cancer incidence rates. The methodology does not allow the definitive linkage of cancer rates to potential causal risk factors, and specific hazardous substances of concern and exposure risk are not addressed by this report.

## DATA AND METHODS

### Study Design

This investigation is a retrospective (i.e., looking backward in time) 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 potential 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 five-year analytical periods for each cancer category among residents of the study area, are compared to the corresponding expected cancer incidence counts derived from the rates for the rest of the state of Utah. The study's null hypothesis (the usual statistical default position) is that the cancer rates in the study area are not significantly different from the rates that would be expected if the study area had the same cancer rates as the rest of the state.

### Study Area and Population

The study area was defined as the 2010 U.S. census block groups 2.001 – 2.004 and 3.001 – 3.003 in Grand County, and 9781.001 in San Juan County (**Figure A2**). This area includes all of Grand County and the northern portion of San Juan County, but excludes the city of Monticello. This area largely corresponds to the study area defined in the previous cancer review (EEP, 2013), although redistricting has resulted in some alterations. The most prominent change is that the city of Green River is now completely excluded from the Grand County block groups, and thus the study area. A largely unpopulated area was added to northwest Grand County as well. Most other changes were simple renumbering of block groups.

The study population was all residents living in the study area, which totaled 11,007 in the 2010 census. Population estimates from 2014 indicate the study area population declined slightly to 10,472 (USCB, 2014a).

### Cancer Data

Cancer incidence data on people diagnosed with primary invasive cancer between 1980 and 2014 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 completeness 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, 2017). 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. 2010 census block groups (UEPHTN, 2017).

Some cases have insufficient address information and are not able to be geocoded to a specific x-y coordinate, and thus census block group. For example, for some cases the only address listed is a PO Box. However, some of these cases may rightly belong within the study area (i.e., if the

true address was known, it would fall within the block groups of the study area). For this study, all non-geocoded cases that were able to be georeferenced to Grand County were considered to be in the study population (total of 252). Similarly, all cases that could be georeferenced to ZIP code 84530 were added to the study population, as this ZIP code lies entirely within the study area (total of 26). Portions of six other ZIP codes are included in the study area: 84511, 84515, 84525, 84532, 84535, and 84540. ZIP codes 84515 and 84540 are entirely within the study area, and the only portion of 84532 not included in the study area is the Needles district of Canyonlands National Park and some adjacent land. All cases georeferenced to these three ZIP codes were already included in those georeferenced to Grand County. For ZIP codes 84511, 84525, and 84535, their populations are concentrated in the cities of Blanding, Green River, and Monticello, respectively, which are outside the study area. Cases georeferenced to these ZIP codes were most likely from those cities, and thus were not added to the study population (a total of 282).

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, 2017). 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 cancers into 42 major types by site following the guidance provided by the National Cancer Institute's (NCI) Surveillance, Epidemiology, and End Results (SEER) Program (NCI, 2017a). These 42 UCR site codes are a convenient grouping for conducting surveillance analyses and allow the comparison of the findings in this report to national and state patterns (UCR, 2017).

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. This is also 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.

Overall, 223,283 invasive primary cancer incidence reports among 201,471 individuals were registered by the UCR statewide between 1980 and 2014. Of those, 1,171 persons living in the study area experienced 1,273 new cancers between 1980 and 2014.

**Population Data**

The 2010 U.S. census divides Utah into 1,690 census block groups with a median population of 1,445 people per block group (USCB, 2010). Commercially available U.S. census population data for Utah for the 1970, 1980, 1990, 2000, and 2010 censuses (Geolytics, 2014) were used to estimate annual age-group and sex population counts for each census block group in 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, 2012).

**Analytical Periods**
Seven five-year analytical time periods (1980-1984, 1985-1989, 1990-1994, 1995-1999, 2000-2004, 2005-2009, and 2010-2014) were evaluated for cancer incidence rates and trends over time.

**Age Groups**
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. For each study area census block group, the cancer incidences by cancer type and population count for each combination of age group, gender, and analytical period were calculated. These were added together to generate the age group, gender, 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 2014 estimated population for the state was 2,942,902 (USCB, 2014b).

**Socioeconomic Assessment of the Study and Comparison Populations**
Social determinants of health are complex, integrated, and overlapping social structures and economic systems that are thought to profoundly affect disease morbidity and mortality (Merletti et al., 2011; Song et al., 2011; Ward et al., 2004). A prominent example is education level, where a better education leads to higher income and financial stability, which in turn leads to better health care access, leading to healthier lifestyles and earlier detection and better treatment options for disease (Song et al., 2011). Of particular interest are the population age, race, and ethnicity distributions, as well as education level, employability, 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 2010-2014 five-year estimates of population parameters were used to understand and compare selected demographic and economic characteristics that are important determinants of cancer-related health (USCB, 2014a). These factors contribute to the burden of disease, but are not the risks of concern for this investigation. Ideally, the social determinants of health for the study area should be similar to the comparison population. If the metrics between the two groups are disproportionate, they may confound the interpretation of the results. The characteristics of the study area were compared to those of the state of Utah (**Table 1**). For several important determinants, ACS data was not available at the census block group level; as previously, the ZIP codes that best cover the study area were used in these cases (84515, 84532, and 84540). The 2014 estimated population for these ZIP codes was 9,677, as compared to 10,472 for the study area as a whole.

A substantially smaller percentage of the study area population was born in Utah, which may relate its close proximity to Colorado to the east. Households in the study area were more likely to have been settled longer, with a considerably higher percentage having last moved prior to

**Table 1: Social and economic determinants of health.**

| Parameter | Study Area | State of Utah |
|---|---|---|
| 2014 estimated population | 10,472 | 2,942,902 |
| Percent of population who are children 0-19 years old | 23.8% | 33.6% |
| Percent of population who are adults 65 years or older | 14.0% | 10.0% |
| Percent of population who are of a minority race | 6.4% | 12.7% |
| Percent of population who are Hispanic of Latino | 9.7% | 13.5% |
| Percent of population born in Utah | 43.0%* | 62.2% |
| Percent of population born outside of the U.S. | 5.0% | 9.5% |
| Percent of population who are not U.S. citizens | 2.7%* | 5.3% |
| Percent of adult high school graduates (or higher)* | 90.3%* | 91.0% |
| Percent of adults with a bachelor's degree (or higher)* | 23.4%* | 30.6% |
| Percent of population 16 years or older who are unemployed | 6.5% | 6.9% |
| Percent of total population living in poverty | 15.7%* | 12.8% |
| Percent children 0-17 years old living in poverty | 17.4%* | 14.9% |
| Percent elderly adults 65 years or older living in poverty | 10.4%* | 6.4% |
| Percent of households moved in 2010 or later | 23.9% | 41.0% |
| Percent of households moved in 2000-2009 | 38.2% | 33.3% |
| Percent of households moved in 1999 or earlier | 37.8% | 25.7% |
| Percent of homes built before 1960 | 19.0% | 18.7% |
| Percent of homes that are single units | 86.8% | 78.2% |

* Data not available at the census block group level; ZIP codes 84515, 84532, and 84540 were used (estimated 2014 population of 9,677).

1999. Compared to the state as a whole, the study area had a lower percentage of children younger than 19 years old and a higher percentage of adults older than 65 years, indicating that the study area population trends older.

Reflecting its less urban nature than the major metropolitan areas of the state, fewer of the study area population were of minority race, Hispanic or Latino, were born outside of the U.S., or were not U.S. citizens. In general, higher proportions of these health determinants may indicate a variety of barriers to health care services and preventive health knowledge, including cultural, language, and legal obstacles. More of the study population was living in poverty, which similarly shows the potential for less access to health care, screening services, and other preventive and early interventions. Interpretation of the study findings should bear in mind that these factors may influence the results.

**Behavioral Risk Factors**

Tobacco use, chronic alcohol use, and obesity are well-known risk factors for many types of cancer. The UDOH conducts annual telephone surveys in Utah known as the Behavioral Risk Factors Survey System (BRFSS) (UDOH, 2017a). These data are made publicly available on the

**Table 2: Behavioral determinants of health.**
Results are in percent, with 95% confidence intervals in parentheses. Grand County is the small area geography best corresponding to the study area.

| Parameter | Grand County* | State of Utah |
|---|---|---|
| Percent of population who smokes | 22.0 (16.5 - 28.9) | 10.5 (10.2 - 10.8) |
| Percent of population who are chronic drinkers of alcohol | 7.3 (4.6 - 11.3) | 3.7 (3.5 - 3.9) |
| Percent of adults who are overweight or obese (BMI 25+) | 60.9 (54.1 - 67.3) | 60.6 (60.1 - 61.1) |
| Percent of population who do not participate in leisure time physical activities (sports, hobbies, etc.) | 20.8 (15.1 - 28.0) | 19.0 (18.6 - 19.4) |
| Percent of population who do not get the recommended level of aerobic physical activity (2011-2013) | 37.6 (28.2 - 48.1) | 41.5 (40.7 - 42.3) |
| Percent of population with insufficient fruit in diet (2011-2013) | 71.2 (60.7 - 79.9) | 68.9 (68.1 - 69.7) |
| Percent of population with insufficient vegetable in diet (2011-2013) | 80.6 (71.7 - 87.2) | 82.5 (81.8 - 83.2) |
| Percent of population who do not have health care insurance | 21.3 (15.8 - 28.1) | 16.4 (16.0 - 16.8) |
| Percent of population who have not had a medical checkup in the past 12 months | 48.3 (41.5 - 55.1) | 41.7 (41.3 - 42.2) |
| Percent of population who have not received dental care in the past 12 months | 45.1 (36.2 - 54.3) | 31.2 (30.6 - 31.8) |
| Percent of population who are not able to get needed health care due to costs | 24.1 (18.5 - 30.8) | 15.3 (14.9 - 15.7) |

* Estimated 2014 population 9,429

Indicator-Based Information System for Public Health (IBIS-PH) website tabulated using a geography known as a small area. The small area units are aggregations of one or more ZIP code areas based on specific criteria, including population size (at least 20,000 persons), political boundaries of cities and towns, and economic similarity (UDOH, 2016). The small area corresponding best to the study area was 05_57.1 Grand County; its 2014 estimated population was 9,429 compared to 10,472 for the entire study area. The BRFSS data were queried for behavioral risk factors as well as access and utilization of health care. Except where indicated, data from 2010 to 2014 were used for the queries (UDOH, 2017b). All results are adjusted for age.

In general, the study population exhibited fewer healthy behaviors than the state as a whole. In particular, a much higher percentage of the study area population smokes and chronically drinks alcohol. Additionally, fewer people living in the study area had health insurance, have had a recent medical or dental checkup, or were able to afford needed health care. All of these elements may be significant risk factors for chronic diseases like cancer, and may also interact in

complex ways. Conversely, study area adults were not more likely to be overweight or obese than the state in general, but were more likely to get at least the recommended level of aerobic physical activity, perhaps reflecting the many available recreational opportunities in the area.

It is important to note that as these data cannot be cross referenced to the cancer data, this investigation cannot control for these potential socioeconomic and behavioral confounders. For example, while the percentage of adult smokers was higher in the study area than the state average, and smoking is the most important risk factor for lung cancer, we do not know which, if any, of the lung cancer cases were also smokers. Additionally, there is typically a long (though variable) time period between exposure to a cancer-causing agent and the diagnosis of cancer; this latency period is often measured in decades. Data from the BRFSS on smoking status does not exist prior to 2009, and there is little available information on the above socioeconomic and behavioral risk factors that may have influenced cancer outcomes during many of this study's analytical periods. Additionally, there are likely to be a variety of unknown and unmeasured determinants that may have played a role, such as occupational risk factors.

**Indirect Age-Standardized Incidence Rates**

The statistical analysis program R version 3.4.1 was used to manage and analyze the data (R, 2017). 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 numbers of cases 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 (see EEP, 2016 for detailed information, including formulas).

**Standardized Incidence Ratios**

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. For statistical validity, SIRs and corresponding 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 and therefore suppresses results for analytical time periods containing three or fewer cases (EEP, 2016).

Statistical significance is determined by applying the Byar's 99% confidence interval for the SIR (Breslow and Day, 1987; Rothman and Boice, 1979, 1982; Sahai and Khurshid, 1983, 1996). The EEP adopted the 99% confidence level following discussions at the local, state, and national stages, and is used due to the multiple comparisons conducted in this study type (Anderson et al., 2012; EEP, 2016). Statistical significance focuses on minimizing false positive interpretations. A false positive occurs when the results appear to be elevated but in reality are simply due to random variation. It should be noted that a statistically significant SIR may be due to mathematical artifacts and not truly be biologically meaningful or relevant (Bender et al., 1990;

Besag and Newell, 1991). When performing multiple analyses using the 99% confidence interval to interpret data, one would expect approximately 1 in 100 (1%) of the analyses to have a statistically significant interpretation as a result of random chance. Additional criteria to help identify meaningful results include any final analytical period where the SIR is three or more standard errors above 1.0, as this may indicate an emerging cluster. Situations where some of these criteria are met but that do not include the final analytical period are considered historical clusters that have resolved, and are thus not actionable (EEP, 2016).

### Analysis of Temporal Trend

The Kendall Tau-b (or Kendall rank correlation coefficient) test for trend was used to test for temporal trends of increasing or decreasing cancer incidence rates (Kendall, 1938). The Kendall Tau-b statistic is an appropriate method to investigate trends when there are relatively few analytical periods. The Kendall Tau-b tests the correlation between the analytical period rate and the ordered numeric designation of the analytical periods (i.e., analytical period 1980 – 1984 is number 1, period 1985 – 1989 is number 2, etc.). The values of Tau-b range from -1 (a consistent decreasing trend) to +1 (a consistent increasing trend). Values near zero indicate no trend. Trend was indicated by statistically significant (p-value $\leq 0.05$) correlation coefficients (corresponding roughly to a Tau-b of $\pm 0.70$).

## FINDINGS

### Statistically Significant Cancer Results

Significantly elevated cancer incidence rates, and the associated standardized incidence ratios, are presented in **Table 3**. Comparisons for every cancer type / analytical period / gender combination are shown in **Table A1**; the statistically significant results found in **Table 3** are indicated with shading and bold text.

Cancers of the lung and bronchus were significantly elevated among males, females, and both genders combined during a variety of analytical periods (**Figure A3**). In males, the rate of lung and bronchial cancer was significantly higher in the study area in all but two periods (1980-1989 and 2005-2009). In females, lung and bronchial cancer was only elevated during the 1995-1999 periods, but was statistically indistinguishable from the rates in the rest of the state in the other analytical periods. When both genders are combined, the rate of lung and bronchial cancer was significantly elevated in all analytical periods except the 2005-2009 period, primarily driven by the comparatively high rates in men. These results suggest the existence of a temporal lung cancer cluster in the study area, particularly among men.

The rate of cervical cancer was significantly elevated during the 1980-1984 analytical period (see **Table 3 and Table A1**). However, this included only a single period and was not the final analytical period. It may show the end of a historical cluster that ended during the first analytical period, or it may represent a normal fluctuation in the data.

**Table 3: Cancers with significantly elevated rate ratios in the study area.**
The total number of study area cases is 1,273. Rates are indirectly standardized incidence rates per 100,000 person years. The SIRs are standardized incidence ratios (SIR) with Byar's 99% confidence intervals (CI). Gender codes are "M" for male, "F" for female, and "B" for both combined. Case counts with '>3' means the case count was large enough to evaluate, but was suppressed to protect confidential data.

| Cancer Site | Time Period | Gender | Study Area Cases | Rate | SIR | 99% CI |
|---|---|---|---|---|---|---|
| 13 Lung and Bronchus | 1980-1984 | M | >3 | 112.5 | 3.3 | 1.89 - 5.44 |
| | 1990-1994 | | 18 | 88.4 | 2.0 | 1.01 - 3.62 |
| | 1995-1999 | | 25 | 110.0 | 2.8 | 1.57 - 4.60 |
| | 2000-2004 | | 26 | 106.0 | 2.8 | 1.59 - 4.57 |
| | 2010-2014 | | 21 | 77.0 | 2.3 | 1.18 - 3.86 |
| | 1995-1999 | F | 14 | 59.7 | 2.5 | 1.11 - 4.78 |
| | 1980-1984 | B | 29 | 62.8 | 2.8 | 1.62 - 4.38 |
| | 1985-1989 | | 25 | 59.7 | 2.3 | 1.27 - 3.72 |
| | 1990-1994 | | 24 | 58.2 | 1.8 | 1.01 - 3.04 |
| | 1995-1999 | | 39 | 84.5 | 2.7 | 1.70 - 4.00 |
| | 2000-2004 | | 35 | 70.7 | 2.3 | 1.44 - 3.55 |
| | 2010-2014 | | 34 | 63.8 | 2.0 | 1.22 - 3.05 |
| 20 Cervix | 1980-1984 | F | 8 | 34.7 | 5.6 | 1.79 - 13.10 |

**Trends**
Analysis of the changes in the rate of cancer incidence through time (i.e., a trend analysis) identified types of cancer with increasing or decreasing trends. Not all cancer types that are elevated during one or more analytical periods will present a significant trend. Not all cancer types with a significant trend will have significantly elevated cancer incidence rates. However, it is possible that cancer types with a significant trend of increasing incidence will eventually reach a time where the incidence is significantly elevated. To reiterate, Kendall Tau-b values near +1 indicate a strong increasing trend, values near -1 indicate a strong decreasing trend, and values near 0 indicate no trend.

In this study, several significant increasing trends were found; no significant decreasing trends were identified. Significant increasing trends in cancers of the rectum and rectosigmoid junction were found in both males (Tau-b = 0.85; p-value = 0.02) and both genders combined (Tau-b = 0.68; p-value = 0.05). The rate of cancers of the kidney and renal pelvis showed a significant increasing trend when both genders were combined (Tau-b = 0.93; p-value = 0.01), but not when separated. Finally, the rate of non-Hodgkin's lymphoma demonstrated a significant increasing trend, but again only when both genders were combined (Tau-b = 0.68; p-value = 0.05). None of the above cancer types with significant rate trends were found to be significantly elevated in the study area, although it is possible they may become so in the future.

# DISCUSSION

## Cancer

There are a number of distinct cell types that make up the human body, including epithelial cells, connective tissue cells, muscle cells, nerve cells, and blood cells. Each of these types arises from stem cells or progenitor cells that divide and specialize (i.e., differentiate) to become different kinds of tissues, forming organs and organ systems. Rapid cellular division and differentiation occurs throughout fetal development and juvenile maturation. Once adulthood is achieved, cellular division and differentiation is essentially limited to replacement of damaged or dying cells. For example, the adult body replaces white blood cells every thirty days and red blood cells every four months. The process of cell division and differentiation is highly regulated, and when uncontrolled, the process can lead to non-functional growths. These nonfunctional growths are called neoplasms, or more commonly, cysts, polyps, or tumors. Most neoplasms are benign, meaning they lack the ability to invade surrounding tissues or metastasize (spread to other parts of the body) and can usually be treated or removed. Neoplasms that are malignant, also known as cancers, have the ability to invade surrounding tissues or metastasize (King and Robins, 2006; Weinberg, 2006).

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 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 and result in adverse health effects (ACS, 2017a; Goodman and Samet, 2006). The American Cancer Society (ACS) estimates that nearly one in two men and more than one in three women will develop cancer at some point in their life (ACS, 2016; NCI, 2017b). In the U.S., cancer is the second leading cause of death (CDC, 2017). Among all causes of death, approximately one in four men and one in five women will die of cancer (ACS, 2016; NCI, 2017b). 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, etc.), medical conditions and medications, oncogenic pathogens, and chemical or radiological environmental exposures. Cancers often result from the interaction of several external factors coupled with an initiating triggering event (ACS, 2017a; Goodman and Samet, 2006; NCI, 2015).

## Cancer Sites

The ACS and NCI maintain websites specific to cancer by type or anatomical site (ACS, 2017b; NCI, 2017c). Links to the relevant websites are available in the References and Resources sections of this document, and readers interested in further information are encouraged to explore them. This report will briefly describe what is known about risk factors for lung and bronchial cancer.

*Lung and Bronchial Cancer*

Lung cancer is the leading cause of cancer-related mortality in the United States, causing about one in four cancer deaths (ACS, 2017c; Alberg and Samet, 2003; Alberg et al., 2007; Molina et al., 2009; NCI, 2017d). It is the second most common cancer in both men and women, after prostate cancer and breast cancer respectively (ACS, 2017c). Approximately one in 14 men and one in 17 women will develop lung cancer during their lifetime, while one in 16 men and one in 20 women will die of lung cancer (ACS, 2016). It is also one of the few types of cancer that has been linked to environmental exposure to alpha-emitting radiation (Coggle et al., 1986; Mould, 2001; Nermina, 2005; Shottenfeld and Fraumeni, 1996; Tomasek et al., 1993).

There are two main types of lung cancer, which are differentiated by their appearance under a microscope: small cell lung cancer and non-small cell lung cancer. Small cell cancers comprise approximately 10-15% of lung cancers while non-small cell cancers make up 80-85% of lung cancers, with less common types comprising the remainder (ACS, 2017c; NCI, 2017d). Within the non-small cell category are several types, the most common of which are squamous cell carcinoma, large cell carcinoma, and adenocarcinoma. This investigation does not differentiate between the different kinds of lung cancer.

By far the most important risk factor for both small cell and non-small cell cancers is smoking. Smoking cigars and pipes is thought to be almost as likely to cause lung cancer as cigarette smoking. The earlier in life a person starts smoking, the more often a person smokes, and the more years a person smokes, the greater the risk of lung cancer. Approximately 80% of lung cancer deaths are thought to result from smoking. This is particularly true for small cell lung cancer; it is very rare for someone who has never smoked to develop small cell lung cancer. As with active smoking, breathing in secondhand tobacco smoke is a known risk factor for lung cancer, thought to cause over 7,000 deaths each year (ACS, 2017c; NCI, 2017d).

Exposure to radon is the second leading cause of lung cancer in the U.S., contributing to 15,000-22,000 lung cancer deaths each year (NCI, 2017e). Radon is an odorless, tasteless, colorless, radioactive gas released by the normal breakdown of elements like uranium in rocks and soil. Radon can enter homes through cracks in floors, walls, or foundations, and accumulate inside. When radon decays, it releases radioactive particles called alpha particles. Normally, these are unable to travel far in air and can be stopped by a piece of paper or the outer layer of skin. However, when radon is inhaled, the alpha particles can damage the cells that line the lung; long-term exposure can lead to lung cancer (NCI, 2017e). **Figure A4** shows a map of radon hazard potential based on geology. Moab and much of the surrounding area is in a region of 'moderate' radon potential. However, a great deal depends on the geology at a specific location as well as the construction of individual buildings. While results from some residential radon tests are reported to the state, there is no comprehensive sampling scheme and the available data are sparse and not likely to be representative.

As with radon, exposure to radiation from other sources, such as imaging tests (e.g., CT scans) and radiation therapy, can also increase the risk of lung cancer. Other risk factors for lung cancer include asbestos exposure; respiratory exposure to substances like uranium, chromium, nickel, beryllium, arsenic, diesel exhaust, and soot or tar; exposure to air pollution; and having a personal or family history of lung cancer (ACS, 2017c; NCI, 2017d). Many of these factors

interact with smoking and result in higher risks of lung cancer. For example, smokers exposed to risk factors like asbestos or radon have much higher lung cancer risks than people exposed to just one of the factors.

**Limitations**

The public often wants public health investigations to link cancer risk to a putative environmental concern. The methodology used in this investigation (i.e., calculation of indirectly standardized incidence ratios) does not have the capability to definitively link elevated cancer rates in the study population to any inherent or external risk factors, including environmental exposures (dos Santos Silva, 1999; Esteve et al., 1994; Jekel et al., 1996; Kingsley et al., 2007; Mann, 2003).

These kinds of cancer statistical reviews are based on annual incidence data reported to the Utah Cancer Registry. The incidence of cancer per year is dependent on the diagnoses of clinically manifested cancers, and there are a number of limitations that can impede this linkage. There is seldom any knowledge about the frequency, duration, or intensity of exposure to potential environmental concerns in cancer victims. Cancer can also have a variable length latency period (period between exposure and the actual manifestation and diagnosis of cancer). Cancer can be present for a substantial amount of time before an individual seeks medical assistance that leads to diagnosis (Bray and Parkin, 2009; Izquierdo and Schoenbach, 2000; Parkin and Bray, 2009; Thoburn et al., 2007).

Cancer risk is thought to be the result of complex interactions between individual factors (e.g., genetics, behaviors, socio-economics, etc.) and environmental exposures (e.g., occupational exposures, domestic exposures, etc.). 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 environmental concern in question (Chaix et al., 2010; Merlo et al., 2012; Peterson et al., 2006; Prentice and Thomas, 1993). For small populations, the incidence of cancer has a tendency to manifest in arbitrary clusters. This tendency is a common phenomenon encountered when investigating the rate of rare diseases in small populations. Often, a few types of cancer may be statistically elevated for disparate periods, but that conclusion may change if the analytical periods are changed (Greenland et al., 1986, 2000). 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 Bureau. 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 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 also contain records of incidence of cancer in persons who recently moved to the study area prior to their diagnosis. Alternatively, the UCR may lack records on individuals who lived for most of their life in the study area but moved elsewhere before seeking diagnosis and treatment. These situations create sampling biases. In the absence of information, this investigation assumes that the sampling bias is non-systematic, meaning 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, who 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.

This investigation used population-based summary data rather than individual-level data. An investigation of this type is termed an ecologic study. An interpretation error commonly associated with ecologic investigations is to apply population-level risk findings to individuals. This kind of interpretation error is called an "ecologic fallacy." For example, this study found the rates of lung and bronchial cancer for study population males in the most recent analytical period to be between 1.18 and 3.86 times higher than the rate in the rest of the state. This risk metric should not be applied to individuals, who 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

Lung and bronchial cancer rates in the study area were significantly elevated for all time periods in men except 1980-1984 and 2005-2009, in the 1995-1999 period in women, and in all but the 2005-2009 period when both genders were combined. In men, the increased risk ranged from 2.0 to 3.3 times higher than expected, based on rates in the rest of the state. With combined genders, the increased risk was 1.8 to 2.8 times higher than expected. See **Figure A3** for a graphical representation of these results, and **Table 3** for a tabular presentation. These findings suggest the presence of a temporal cluster of lung and bronchial cancer in Moab among men. Lung cancer rates in women were significantly elevated only during the 1995-1999 time period, which does not indicate a temporal cluster in females.

Cervical cancer was elevated during the first time period (1980-1984). This may show the end of a historical cluster that ended during the first analytical period, or it may represent a normal fluctuation in the data.

The EEP recommends that SEUHD work with relevant programs within the Utah Department of Health, such as the Cancer Control Program and the Tobacco Prevention and Control Program, to identify screening and health education services that could be made available to study area residents. As with most cancers, early detection and intervention for lung cancer can dramatically improve the prognosis for recovery and quality of life experience. Residents are encouraged to be aware of cancer risk and those social and behavioral factors in their control, and to work with their local health department and health care provider for screening. Because some cancer types have long latency periods, continued follow-up of this study area is

recommended. The EEP recommends that SEUHD continue to request follow-up studies in approximately five year periods as new cancer data becomes available. The next follow-up is recommended to include data from the 2015-2019 time period.

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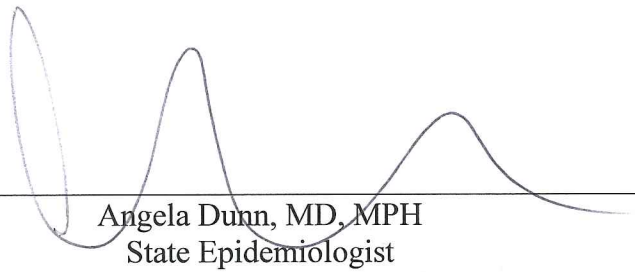
## CERTIFICATION

This report, titled "Cancer Incidence Statistical Review – Five Year Update for Moab, Grand County, Utah, Covering the Period from 1980 to 2014", 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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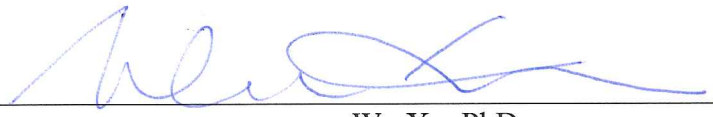

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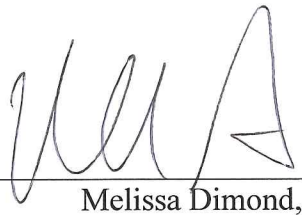

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# APPENDICES

**Figure A1: Moab UMTRA site features.**
View of the Moab uranium mill tailings site looking north. The city of Moab is across the river to the southeast. Figure from DOE, 2017.

**Figure A2: Study area map.**
Map of the study area, shown in orange, in Grand and San Juan Counties. The study area consists of census block groups 2.001 – 2.004 and 3.001 – 3.003 in Grand County, and 9781.001 in San Juan County.

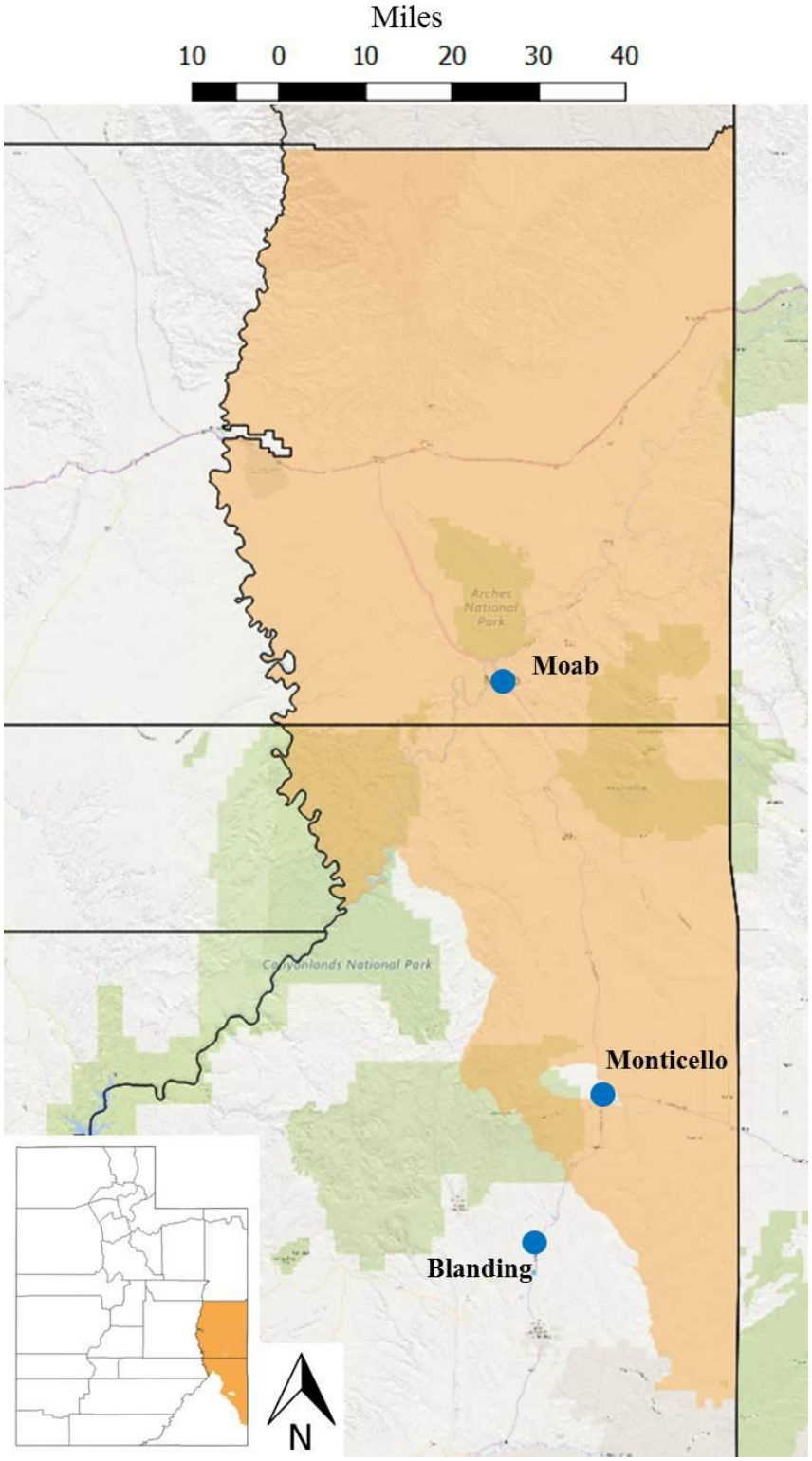


**Figure A3: Relative rates for lung and bronchial cancers.**
The indirectly standardized rate ratios for men, women, and both genders combined are shown below. The error bars denote the 99% upper and lower confidence limits. If the error bars do not cross 1.0 (the dashed line), the rate ratio is significantly elevated compared to the rest of Utah.

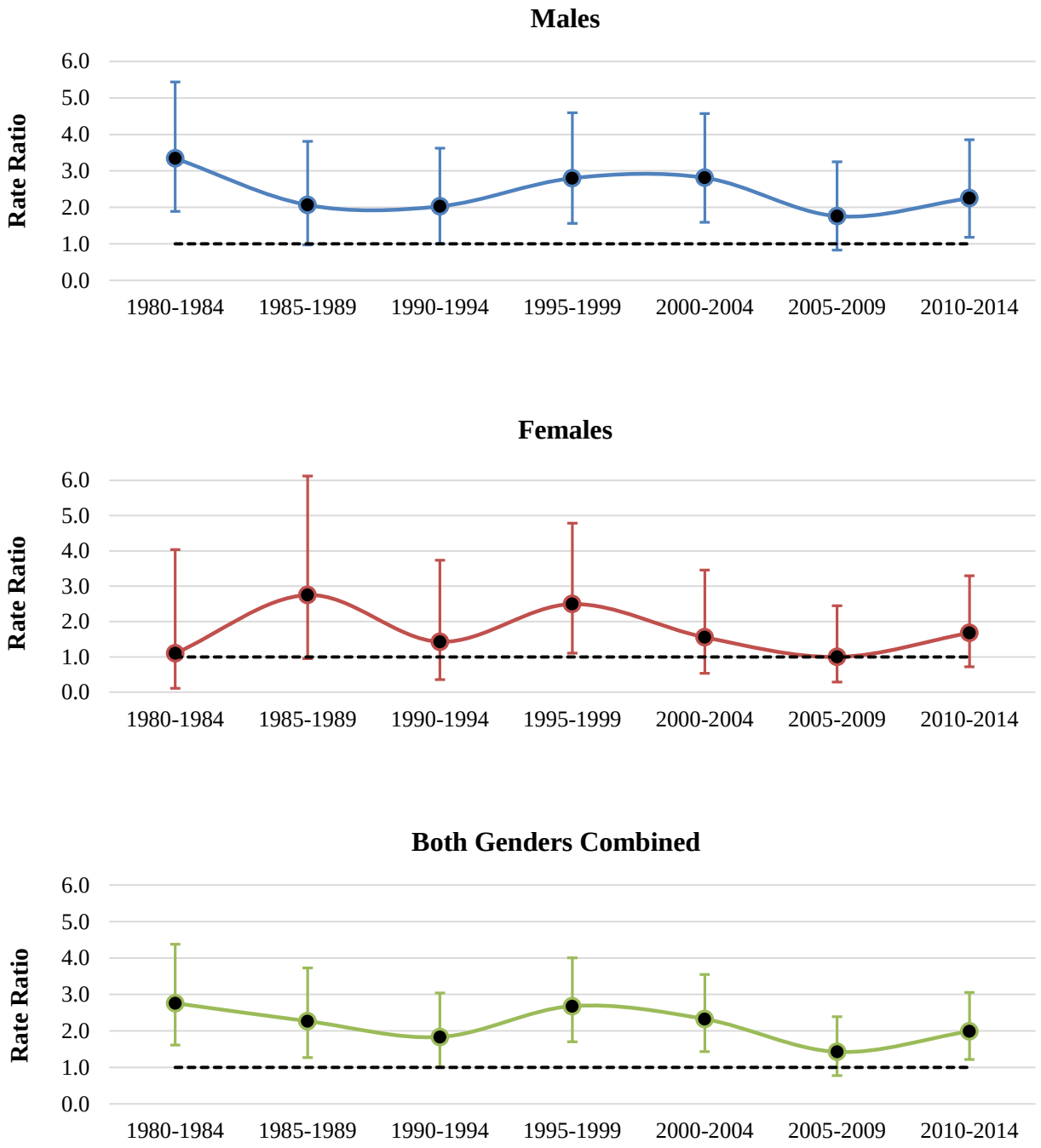
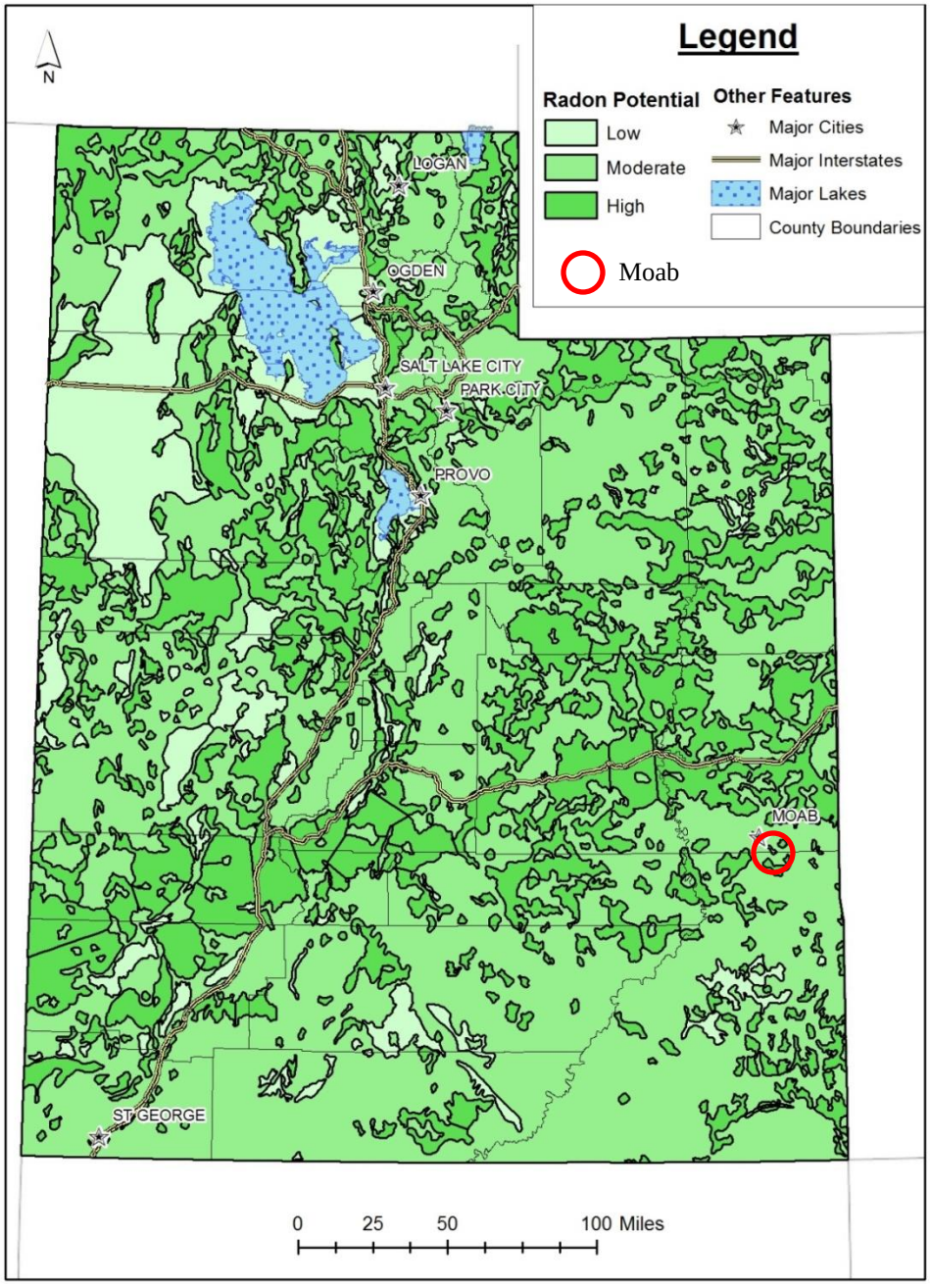


**Figure A4: Radon hazard potential in Utah based on geology, 1993.**
This is a digitized version of a map created by the Utah Geological Survey in 1993. The outlines on this map represent the counties of Utah. Information about radon and this map may be found at: epht.health.utah.gov/epht-view/indicator/view/Radon.Map.html




Low risk: The geology of this area will likely result in a radon test result of <2 picoCuries per liter of air (pCi/L).

Medium risk: The geology of this area will likely result in a test result at 2-4 pCi/L.

High risk: The geology of this area will likely result in a test result over the EPA action level of 4 pCi/L.

**Table A1: Study results by cancer type, analytical period, and gender.**
Analysis of the incidence of primary cancer diagnoses among study area residents between 1980 and 2014 reported to the Utah Cancer Registry by site code. Case counts with '≤3' indicate a stratum with three or fewer cases, resulting in suppression of the results. Case counts with '>3' means the case count was large enough to evaluate, but was suppressed to protect confidential data. Rates are indirect age-standardized incidence rates per 100,000 person-years. The SIRs are the standardized incidence ratios (SIR) with Byar's 99% confidence intervals. Statistical significance is indicated by shading and bold text. Gender codes are "M" for male, "F" for female, and "B" for both genders combined.

| Cancer Site | Analytical Period | Gender | Study Area Cases | Rate | SIR | 99% Confidence Interval |
|---|---|---|---|---|---|---|
| 01 Oral cavity & pharynx | 1980-1984 | M | ≤3 | | | |
| | | F | ≤3 | | | |
| | | B | ≤3 | | | |
| | 1985-1989 | M | ≤3 | | | |
| | | F | ≤3 | | | |
| | | B | ≤3 | | | |
| | 1990-1994 | M | ≤3 | | | |
| | | F | ≤3 | | | |
| | | B | ≤3 | | | |
| | 1995-1999 | M | >3 | 26.41 | 2.19 | 0.55 - 5.72 |
| | | F | ≤3 | | | |
| | | B | 7 | 15.16 | 1.76 | 0.50 - 4.31 |
| | 2000-2004 | M | >3 | 24.47 | 2.10 | 0.53 - 5.48 |
| | | F | ≤3 | | | |
| | | B | 7 | 14.13 | 1.63 | 0.47 - 4.00 |
| | 2005-2009 | M | ≤3 | | | |
| | | F | ≤3 | | | |
| | | B | ≤3 | | | |
| | 2010-2014 | M | ≤3 | | | |
| | | F | >3 | 15.39 | 2.44 | 0.39 - 7.69 |
| | | B | 6 | 11.27 | 1.08 | 0.27 - 2.82 |

**Table A1: Study results by cancer type, analytical period, and gender (continued).**
Analysis of the incidence of primary cancer diagnoses among study area residents between 1980 and 2014 reported to the Utah Cancer Registry by site code. Case counts with '≤3' indicate a stratum with three or fewer cases, resulting in suppression of the results. Case counts with '>3' means the case count was large enough to evaluate, but was suppressed to protect confidential data. Rates are indirect age-standardized incidence rates per 100,000 person-years. The SIRs are the standardized incidence ratios (SIR) with Byar's 99% confidence intervals. Statistical significance is indicated by shading and bold text. Gender codes are "M" for male, "F" for female, and "B" for both genders combined.

| Cancer Site | Analytical Period | Gender | Study Area Cases | Rate | SIR | 99% Confidence Interval |
|---|---|---|---|---|---|---|
| 02 Esophagus | 1980-1984 | M | ≤3 | | | |
| | | F | ≤3 | | | |
| | | B | ≤3 | | | |
| | 1985-1989 | M | ≤3 | | | |
| | | F | ≤3 | | | |
| | | B | ≤3 | | | |
| | 1990-1994 | M | ≤3 | | | |
| | | F | ≤3 | | | |
| | | B | ≤3 | | | |
| | 1995-1999 | M | ≤3 | | | |
| | | F | ≤3 | | | |
| | | B | ≤3 | | | |
| | 2000-2004 | M | ≤3 | | | |
| | | F | ≤3 | | | |
| | | B | ≤3 | | | |
| | 2005-2009 | M | >3 | 15.60 | 2.48 | 0.40 - 7.82 |
| | | F | ≤3 | | | |
| | | B | >3 | 7.87 | 2.07 | 0.33 - 6.54 |
| | 2010-2014 | M | ≤3 | | | |
| | | F | ≤3 | | | |
| | | B | ≤3 | | | |

**Table A1: Study results by cancer type, analytical period, and gender (continued).**
Analysis of the incidence of primary cancer diagnoses among study area residents between 1980 and 2014 reported to the Utah Cancer Registry by site code. Case counts with '≤3' indicate a stratum with three or fewer cases, resulting in suppression of the results. Case counts with '>3' means the case count was large enough to evaluate, but was suppressed to protect confidential data. Rates are indirect age-standardized incidence rates per 100,000 person-years. The SIRs are the standardized incidence ratios (SIR) with Byar's 99% confidence intervals. Statistical significance is indicated by shading and bold text. Gender codes are "M" for male, "F" for female, and "B" for both genders combined.

| Cancer Site | Analytical Period | Gender | Study Area Cases | Rate | SIR | 99% Confidence Interval |
|---|---|---|---|---|---|---|
| 03 Stomach | 1980-1984 | M | ≤3 | | | |
| | | F | ≤3 | | | |
| | | B | ≤3 | | | |
| | 1985-1989 | M | ≤3 | | | |
| | | F | ≤3 | | | |
| | | B | 4 | 10.00 | 1.78 | 0.28 - 5.60 |
| | 1990-1994 | M | ≤3 | | | |
| | | F | ≤3 | | | |
| | | B | ≤3 | | | |
| | 1995-1999 | M | ≤3 | | | |
| | | F | ≤3 | | | |
| | | B | ≤3 | | | |
| | 2000-2004 | M | ≤3 | | | |
| | | F | ≤3 | | | |
| | | B | ≤3 | | | |
| | 2005-2009 | M | ≤3 | | | |
| | | F | ≤3 | | | |
| | | B | ≤3 | | | |
| | 2010-2014 | M | ≤3 | | | |
| | | F | ≤3 | | | |
| | | B | ≤3 | | | |

**Table A1: Study results by cancer type, analytical period, and gender (continued).**
Analysis of the incidence of primary cancer diagnoses among study area residents between 1980 and 2014 reported to the Utah Cancer Registry by site code. Case counts with '≤3' indicate a stratum with three or fewer cases, resulting in suppression of the results. Case counts with '>3' means the case count was large enough to evaluate, but was suppressed to protect confidential data. Rates are indirect age-standardized incidence rates per 100,000 person-years. The SIRs are the standardized incidence ratios (SIR) with Byar's 99% confidence intervals. Statistical significance is indicated by shading and bold text. Gender codes are "M" for male, "F" for female, and "B" for both genders combined.

| Cancer Site | Analytical Period | Gender | Study Area Cases | Rate | SIR | 99% Confidence Interval |
|---|---|---|---|---|---|---|
| 04 Small intestine | 1980-1984 | M | ≤3 | | | |
| | | F | ≤3 | | | |
| | | B | ≤3 | | | |
| | 1985-1989 | M | ≤3 | | | |
| | | F | ≤3 | | | |
| | | B | ≤3 | | | |
| | 1990-1994 | M | ≤3 | | | |
| | | F | ≤3 | | | |
| | | B | ≤3 | | | |
| | 1995-1999 | M | ≤3 | | | |
| | | F | ≤3 | | | |
| | | B | ≤3 | | | |
| | 2000-2004 | M | ≤3 | | | |
| | | F | ≤3 | | | |
| | | B | ≤3 | | | |
| | 2005-2009 | M | ≤3 | | | |
| | | F | ≤3 | | | |
| | | B | ≤3 | | | |
| | 2010-2014 | M | ≤3 | | | |
| | | F | ≤3 | | | |
| | | B | ≤3 | | | |

**Table A1: Study results by cancer type, analytical period, and gender (continued).**
Analysis of the incidence of primary cancer diagnoses among study area residents between 1980 and 2014 reported to the Utah Cancer Registry by site code. Case counts with '≤3' indicate a stratum with three or fewer cases, resulting in suppression of the results. Case counts with '>3' means the case count was large enough to evaluate, but was suppressed to protect confidential data. Rates are indirect age-standardized incidence rates per 100,000 person-years. The SIRs are the standardized incidence ratios (SIR) with Byar's 99% confidence intervals. Statistical significance is indicated by shading and bold text. Gender codes are "M" for male, "F" for female, and "B" for both genders combined.

| Cancer Site | Analytical Period | Gender | Study Area Cases | Rate | SIR | 99% Confidence Interval |
|---|---|---|---|---|---|---|
| 05 Colon | 1980-1984 | M | ≤3 | | | |
| | | F | >3 | 17.32 | 0.87 | 0.14 - 2.73 |
| | | B | 5 | 10.82 | 0.53 | 0.11 - 1.50 |
| | 1985-1989 | M | 4 | 19.19 | 0.72 | 0.12 - 2.27 |
| | | F | 7 | 33.23 | 1.43 | 0.41 - 3.51 |
| | | B | 11 | 26.25 | 1.05 | 0.41 - 2.18 |
| | 1990-1994 | M | ≤3 | | | |
| | | F | >3 | 28.80 | 1.15 | 0.29 - 3.00 |
| | | B | 9 | 21.84 | 0.77 | 0.27 - 1.71 |
| | 1995-1999 | M | 4 | 17.61 | 0.58 | 0.09 - 1.84 |
| | | F | 6 | 25.59 | 0.95 | 0.24 - 2.48 |
| | | B | 10 | 21.66 | 0.76 | 0.28 - 1.62 |
| | 2000-2004 | M | ≤3 | | | |
| | | F | >3 | 23.98 | 0.84 | 0.21 - 2.19 |
| | | B | 9 | 18.17 | 0.61 | 0.21 - 1.36 |
| | 2005-2009 | M | 12 | 46.81 | 1.66 | 0.68 - 3.34 |
| | | F | 4 | 15.90 | 0.56 | 0.09 - 1.76 |
| | | B | 16 | 31.50 | 1.11 | 0.52 - 2.05 |
| | 2010-2014 | M | 6 | 22.00 | 0.86 | 0.22 - 2.24 |
| | | F | 6 | 23.09 | 0.96 | 0.24 - 2.50 |
| | | B | 12 | 22.53 | 0.90 | 0.37 - 1.82 |

**Table A1: Study results by cancer type, analytical period, and gender (continued).**
Analysis of the incidence of primary cancer diagnoses among study area residents between 1980 and 2014 reported to the Utah Cancer Registry by site code. Case counts with '≤3' indicate a stratum with three or fewer cases, resulting in suppression of the results. Case counts with '>3' means the case count was large enough to evaluate, but was suppressed to protect confidential data. Rates are indirect age-standardized incidence rates per 100,000 person-years. The SIRs are the standardized incidence ratios (SIR) with Byar's 99% confidence intervals. Statistical significance is indicated by shading and bold text. Gender codes are "M" for male, "F" for female, and "B" for both genders combined.

| Cancer Site | Analytical Period | Gender | Study Area Cases | Rate | SIR | 99% Confidence Interval |
|---|---|---|---|---|---|---|
| 06 Rectum & rectosigmoid junction | 1980-1984 | M | ≤3 | | | |
| | | F | ≤3 | | | |
| | | B | ≤3 | | | |
| | 1985-1989 | M | ≤3 | | | |
| | | F | ≤3 | | | |
| | | B | ≤3 | | | |
| | 1990-1994 | M | ≤3 | | | |
| | | F | ≤3 | | | |
| | | B | ≤3 | | | |
| | 1995-1999 | M | ≤3 | | | |
| | | F | ≤3 | | | |
| | | B | ≤3 | | | |
| | 2000-2004 | M | ≤3 | | | |
| | | F | ≤3 | | | |
| | | B | 5 | 10.09 | 0.86 | 0.18 - 2.45 |
| | 2005-2009 | M | 4 | 15.60 | 1.11 | 0.18 - 3.50 |
| | | F | 6 | 23.85 | 2.55 | 0.64 - 6.67 |
| | | B | 10 | 19.69 | 1.68 | 0.62 - 3.59 |
| | 2010-2014 | M | 5 | 18.34 | 1.45 | 0.30 - 4.10 |
| | | F | 5 | 19.24 | 1.91 | 0.40 - 5.42 |
| | | B | 10 | 18.78 | 1.65 | 0.61 - 3.53 |

**Table A1: Study results by cancer type, analytical period, and gender (continued).**
Analysis of the incidence of primary cancer diagnoses among study area residents between 1980 and 2014 reported to the Utah Cancer Registry by site code. Case counts with '≤3' indicate a stratum with three or fewer cases, resulting in suppression of the results. Case counts with '>3' means the case count was large enough to evaluate, but was suppressed to protect confidential data. Rates are indirect age-standardized incidence rates per 100,000 person-years. The SIRs are the standardized incidence ratios (SIR) with Byar's 99% confidence intervals. Statistical significance is indicated by shading and bold text. Gender codes are "M" for male, "F" for female, and "B" for both genders combined.

| Cancer Site | Analytical Period | Gender | Study Area Cases | Rate | SIR | 99% Confidence Interval |
|---|---|---|---|---|---|---|
| 07 Anus, anal canal, & anorectum | 1980-1984 | M | ≤3 | | | |
| | | F | ≤3 | | | |
| | | B | ≤3 | | | |
| | 1985-1989 | M | ≤3 | | | |
| | | F | ≤3 | | | |
| | | B | ≤3 | | | |
| | 1990-1994 | M | ≤3 | | | |
| | | F | ≤3 | | | |
| | | B | ≤3 | | | |
| | 1995-1999 | M | ≤3 | | | |
| | | F | ≤3 | | | |
| | | B | ≤3 | | | |
| | 2000-2004 | M | ≤3 | | | |
| | | F | ≤3 | | | |
| | | B | ≤3 | | | |
| | 2005-2009 | M | ≤3 | | | |
| | | F | ≤3 | | | |
| | | B | ≤3 | | | |
| | 2010-2014 | M | ≤3 | | | |
| | | F | ≤3 | | | |
| | | B | ≤3 | | | |

**Table A1: Study results by cancer type, analytical period, and gender (continued).**
Analysis of the incidence of primary cancer diagnoses among study area residents between 1980 and 2014 reported to the Utah Cancer Registry by site code. Case counts with '≤3' indicate a stratum with three or fewer cases, resulting in suppression of the results. Case counts with '>3' means the case count was large enough to evaluate, but was suppressed to protect confidential data. Rates are indirect age-standardized incidence rates per 100,000 person-years. The SIRs are the standardized incidence ratios (SIR) with Byar's 99% confidence intervals. Statistical significance is indicated by shading and bold text. Gender codes are "M" for male, "F" for female, and "B" for both genders combined.

| Cancer Site | Analytical Period | Gender | Study Area Cases | Rate | SIR | 99% Confidence Interval |
|---|---|---|---|---|---|---|
| 08 Liver & interhepatic bile duct | 1980-1984 | M | ≤3 | | | |
| | | F | ≤3 | | | |
| | | B | ≤3 | | | |
| | 1985-1989 | M | ≤3 | | | |
| | | F | ≤3 | | | |
| | | B | ≤3 | | | |
| | 1990-1994 | M | ≤3 | | | |
| | | F | ≤3 | | | |
| | | B | ≤3 | | | |
| | 1995-1999 | M | ≤3 | | | |
| | | F | ≤3 | | | |
| | | B | ≤3 | | | |
| | 2000-2004 | M | ≤3 | | | |
| | | F | ≤3 | | | |
| | | B | ≤3 | | | |
| | 2005-2009 | M | ≤3 | | | |
| | | F | ≤3 | | | |
| | | B | ≤3 | | | |
| | 2010-2014 | M | >3 | 18.34 | 1.78 | 0.37 - 5.05 |
| | | F | ≤3 | | | |
| | | B | 6 | 11.27 | 1.52 | 0.38 - 3.98 |

**Table A1: Study results by cancer type, analytical period, and gender (continued).**
Analysis of the incidence of primary cancer diagnoses among study area residents between 1980 and 2014 reported to the Utah Cancer Registry by site code. Case counts with '≤3' indicate a stratum with three or fewer cases, resulting in suppression of the results. Case counts with '>3' means the case count was large enough to evaluate, but was suppressed to protect confidential data. Rates are indirect age-standardized incidence rates per 100,000 person-years. The SIRs are the standardized incidence ratios (SIR) with Byar's 99% confidence intervals. Statistical significance is indicated by shading and bold text. Gender codes are "M" for male, "F" for female, and "B" for both genders combined.

| Cancer Site | Analytical Period | Gender | Study Area Cases | Rate | SIR | 99% Confidence Interval |
|---|---|---|---|---|---|---|
| 09 Gallbladder & biliary ducts | 1980-1984 | M | ≤3 | | | |
| | | F | ≤3 | | | |
| | | B | ≤3 | | | |
| | 1985-1989 | M | ≤3 | | | |
| | | F | ≤3 | | | |
| | | B | ≤3 | | | |
| | 1990-1994 | M | ≤3 | | | |
| | | F | ≤3 | | | |
| | | B | ≤3 | | | |
| | 1995-1999 | M | ≤3 | | | |
| | | F | ≤3 | | | |
| | | B | ≤3 | | | |
| | 2000-2004 | M | ≤3 | | | |
| | | F | ≤3 | | | |
| | | B | ≤3 | | | |
| | 2005-2009 | M | ≤3 | | | |
| | | F | ≤3 | | | |
| | | B | ≤3 | | | |
| | 2010-2014 | M | ≤3 | | | |
| | | F | ≤3 | | | |
| | | B | ≤3 | | | |

**Table A1: Study results by cancer type, analytical period, and gender (continued).**
Analysis of the incidence of primary cancer diagnoses among study area residents between 1980 and 2014 reported to the Utah Cancer Registry by site code. Case counts with '≤3' indicate a stratum with three or fewer cases, resulting in suppression of the results. Case counts with '>3' means the case count was large enough to evaluate, but was suppressed to protect confidential data. Rates are indirect age-standardized incidence rates per 100,000 person-years. The SIRs are the standardized incidence ratios (SIR) with Byar's 99% confidence intervals. Statistical significance is indicated by shading and bold text. Gender codes are "M" for male, "F" for female, and "B" for both genders combined.

| Cancer Site | Analytical Period | Gender | Study Area Cases | Rate | SIR | 99% Confidence Interval |
|---|---|---|---|---|---|---|
| 10 Pancreas | 1980-1984 | M | ≤3 | | | |
| | | F | ≤3 | | | |
| | | B | 5 | 10.82 | 1.88 | 0.39 - 5.33 |
| | 1985-1989 | M | >3 | 19.19 | 2.43 | 0.39 - 7.67 |
| | | F | ≤3 | | | |
| | | B | >3 | 9.55 | 1.37 | 0.22 - 4.33 |
| | 1990-1994 | M | ≤3 | | | |
| | | F | ≤3 | | | |
| | | B | >3 | 14.56 | 1.85 | 0.46 - 4.84 |
| | 1995-1999 | M | ≤3 | | | |
| | | F | ≤3 | | | |
| | | B | ≤3 | | | |
| | 2000-2004 | M | ≤3 | | | |
| | | F | ≤3 | | | |
| | | B | ≤3 | | | |
| | 2005-2009 | M | ≤3 | | | |
| | | F | >3 | 19.87 | 1.85 | 0.39 - 5.23 |
| | | B | 8 | 15.75 | 1.43 | 0.45 - 3.33 |
| | 2010-2014 | M | ≤3 | | | |
| | | F | ≤3 | | | |
| | | B | 4 | 7.51 | 0.59 | 0.09 - 1.85 |

**Table A1: Study results by cancer type, analytical period, and gender (continued).**
Analysis of the incidence of primary cancer diagnoses among study area residents between 1980 and 2014 reported to the Utah Cancer Registry by site code. Case counts with '≤3' indicate a stratum with three or fewer cases, resulting in suppression of the results. Case counts with '>3' means the case count was large enough to evaluate, but was suppressed to protect confidential data. Rates are indirect age-standardized incidence rates per 100,000 person-years. The SIRs are the standardized incidence ratios (SIR) with Byar's 99% confidence intervals. Statistical significance is indicated by shading and bold text. Gender codes are "M" for male, "F" for female, and "B" for both genders combined.

| Cancer Site | Analytical Period | Gender | Study Area Cases | Rate | SIR | 99% Confidence Interval |
|---|---|---|---|---|---|---|
| 11 Other digestive system | 1980-1984 | M | ≤3 | | | |
| | | F | ≤3 | | | |
| | | B | ≤3 | | | |
| | 1985-1989 | M | ≤3 | | | |
| | | F | ≤3 | | | |
| | | B | ≤3 | | | |
| | 1990-1994 | M | ≤3 | | | |
| | | F | ≤3 | | | |
| | | B | ≤3 | | | |
| | 1995-1999 | M | ≤3 | | | |
| | | F | ≤3 | | | |
| | | B | ≤3 | | | |
| | 2000-2004 | M | ≤3 | | | |
| | | F | ≤3 | | | |
| | | B | ≤3 | | | |
| | 2005-2009 | M | ≤3 | | | |
| | | F | ≤3 | | | |
| | | B | ≤3 | | | |
| | 2010-2014 | M | ≤3 | | | |
| | | F | ≤3 | | | |
| | | B | ≤3 | | | |

**Table A1: Study results by cancer type, analytical period, and gender (continued).**
Analysis of the incidence of primary cancer diagnoses among study area residents between 1980 and 2014 reported to the Utah Cancer Registry by site code. Case counts with '≤3' indicate a stratum with three or fewer cases, resulting in suppression of the results. Case counts with '>3' means the case count was large enough to evaluate, but was suppressed to protect confidential data. Rates are indirect age-standardized incidence rates per 100,000 person-years. The SIRs are the standardized incidence ratios (SIR) with Byar's 99% confidence intervals. Statistical significance is indicated by shading and bold text. Gender codes are "M" for male, "F" for female, and "B" for both genders combined.

| Cancer Site | Analytical Period | Gender | Study Area Cases | Rate | SIR | 99% Confidence Interval |
|---|---|---|---|---|---|---|
| 12 Larynx | 1980-1984 | M | ≤3 | | | |
| | | F | ≤3 | | | |
| | | B | ≤3 | | | |
| | 1985-1989 | M | ≤3 | | | |
| | | F | ≤3 | | | |
| | | B | ≤3 | | | |
| | 1990-1994 | M | ≤3 | | | |
| | | F | ≤3 | | | |
| | | B | ≤3 | | | |
| | 1995-1999 | M | ≤3 | | | |
| | | F | ≤3 | | | |
| | | B | ≤3 | | | |
| | 2000-2004 | M | ≤3 | | | |
| | | F | ≤3 | | | |
| | | B | ≤3 | | | |
| | 2005-2009 | M | ≤3 | | | |
| | | F | ≤3 | | | |
| | | B | 4 | 7.87 | 4.01 | 0.64 - 12.67 |
| | 2010-2014 | M | ≤3 | | | |
| | | F | ≤3 | | | |
| | | B | ≤3 | | | |

**Table A1: Study results by cancer type, analytical period, and gender (continued).**
Analysis of the incidence of primary cancer diagnoses among study area residents between 1980 and 2014 reported to the Utah Cancer Registry by site code. Case counts with '≤3' indicate a stratum with three or fewer cases, resulting in suppression of the results. Case counts with '>3' means the case count was large enough to evaluate, but was suppressed to protect confidential data. Rates are indirect age-standardized incidence rates per 100,000 person-years. The SIRs are the standardized incidence ratios (SIR) with Byar's 99% confidence intervals. Statistical significance is indicated by shading and bold text. Gender codes are "M" for male, "F" for female, and "B" for both genders combined.

| Cancer Site | Analytical Period | Gender | Study Area Cases | Rate | SIR | 99% Confidence Interval |
|---|---|---|---|---|---|---|
| 13 Lung & bronchus | **1980-1984** | **M** | **>3** | **112.50** | **3.34** | **1.89 - 5.44** |
| | | F | ≤3 | | | |
| | | **B** | **29** | **62.77** | **2.76** | **1.62 - 4.38** |
| | **1985-1989** | M | 16 | 76.78 | 2.07 | 0.97 - 3.81 |
| | | F | 9 | 42.73 | 2.75 | 0.95 - 6.12 |
| | | **B** | **25** | **59.66** | **2.27** | **1.27 - 3.72** |
| | **1990-1994** | **M** | **18** | **88.36** | **2.03** | **1.01 - 3.62** |
| | | F | 6 | 28.80 | 1.43 | 0.36 - 3.73 |
| | | **B** | **24** | **58.25** | **1.84** | **1.01 - 3.04** |
| | **1995-1999** | **M** | **25** | **110.05** | **2.80** | **1.57 - 4.60** |
| | | **F** | **14** | **59.72** | **2.49** | **1.11 - 4.78** |
| | | **B** | **39** | **84.49** | **2.68** | **1.70 - 4.00** |
| | **2000-2004** | **M** | **26** | **106.04** | **2.81** | **1.59 - 4.57** |
| | | F | 9 | 35.97 | 1.56 | 0.54 - 3.46 |
| | | **B** | **35** | **70.65** | **2.33** | **1.44 - 3.55** |
| | **2005-2009** | M | 16 | 62.41 | 1.76 | 0.83 - 3.25 |
| | | F | 7 | 27.82 | 1.00 | 0.29 - 2.45 |
| | | B | 23 | 45.28 | 1.43 | 0.78 - 2.39 |
| | **2010-2014** | **M** | **21** | **77.01** | **2.25** | **1.18 - 3.86** |
| | | F | 13 | 50.03 | 1.68 | 0.72 - 3.30 |
| | | **B** | **34** | **63.84** | **1.99** | **1.22 - 3.05** |

**Table A1: Study results by cancer type, analytical period, and gender (continued).**
Analysis of the incidence of primary cancer diagnoses among study area residents between 1980 and 2014 reported to the Utah Cancer Registry by site code. Case counts with '≤3' indicate a stratum with three or fewer cases, resulting in suppression of the results. Case counts with '>3' means the case count was large enough to evaluate, but was suppressed to protect confidential data. Rates are indirect age-standardized incidence rates per 100,000 person-years. The SIRs are the standardized incidence ratios (SIR) with Byar's 99% confidence intervals. Statistical significance is indicated by shading and bold text. Gender codes are "M" for male, "F" for female, and "B" for both genders combined.

| Cancer Site | Analytical Period | Gender | Study Area Cases | Rate | SIR | 99% Confidence Interval |
|---|---|---|---|---|---|---|
| 14 Other respiratory system | 1980-1984 | M | ≤3 | | | |
| | | F | ≤3 | | | |
| | | B | ≤3 | | | |
| | 1985-1989 | M | ≤3 | | | |
| | | F | ≤3 | | | |
| | | B | ≤3 | | | |
| | 1990-1994 | M | ≤3 | | | |
| | | F | ≤3 | | | |
| | | B | ≤3 | | | |
| | 1995-1999 | M | ≤3 | | | |
| | | F | ≤3 | | | |
| | | B | ≤3 | | | |
| | 2000-2004 | M | ≤3 | | | |
| | | F | ≤3 | | | |
| | | B | ≤3 | | | |
| | 2005-2009 | M | ≤3 | | | |
| | | F | ≤3 | | | |
| | | B | ≤3 | | | |
| | 2010-2014 | M | ≤3 | | | |
| | | F | ≤3 | | | |
| | | B | ≤3 | | | |

**Table A1: Study results by cancer type, analytical period, and gender (continued).**
Analysis of the incidence of primary cancer diagnoses among study area residents between 1980 and 2014 reported to the Utah Cancer Registry by site code. Case counts with '≤3' indicate a stratum with three or fewer cases, resulting in suppression of the results. Case counts with '>3' means the case count was large enough to evaluate, but was suppressed to protect confidential data. Rates are indirect age-standardized incidence rates per 100,000 person-years. The SIRs are the standardized incidence ratios (SIR) with Byar's 99% confidence intervals. Statistical significance is indicated by shading and bold text. Gender codes are "M" for male, "F" for female, and "B" for both genders combined.

| Cancer Site | Analytical Period | Gender | Study Area Cases | Rate | SIR | 99% Confidence Interval |
|---|---|---|---|---|---|---|
| 15 Bones & joints | 1980-1984 | M | ≤3 | | | |
| | | F | ≤3 | | | |
| | | B | ≤3 | | | |
| | 1985-1989 | M | ≤3 | | | |
| | | F | ≤3 | | | |
| | | B | ≤3 | | | |
| | 1990-1994 | M | ≤3 | | | |
| | | F | ≤3 | | | |
| | | B | ≤3 | | | |
| | 1995-1999 | M | ≤3 | | | |
| | | F | ≤3 | | | |
| | | B | ≤3 | | | |
| | 2000-2004 | M | ≤3 | | | |
| | | F | ≤3 | | | |
| | | B | ≤3 | | | |
| | 2005-2009 | M | ≤3 | | | |
| | | F | ≤3 | | | |
| | | B | ≤3 | | | |
| | 2010-2014 | M | ≤3 | | | |
| | | F | ≤3 | | | |
| | | B | ≤3 | | | |

**Table A1: Study results by cancer type, analytical period, and gender (continued).**
Analysis of the incidence of primary cancer diagnoses among study area residents between 1980 and 2014 reported to the Utah Cancer Registry by site code. Case counts with '≤3' indicate a stratum with three or fewer cases, resulting in suppression of the results. Case counts with '>3' means the case count was large enough to evaluate, but was suppressed to protect confidential data. Rates are indirect age-standardized incidence rates per 100,000 person-years. The SIRs are the standardized incidence ratios (SIR) with Byar's 99% confidence intervals. Statistical significance is indicated by shading and bold text. Gender codes are "M" for male, "F" for female, and "B" for both genders combined.

| Cancer Site | Analytical Period | Gender | Study Area Cases | Rate | SIR | 99% Confidence Interval |
|---|---|---|---|---|---|---|
| 16 Soft tissue (including heart) | 1980-1984 | M | ≤3 | | | |
| | | F | ≤3 | | | |
| | | B | ≤3 | | | |
| | 1985-1989 | M | ≤3 | | | |
| | | F | ≤3 | | | |
| | | B | ≤3 | | | |
| | 1990-1994 | M | ≤3 | | | |
| | | F | ≤3 | | | |
| | | B | ≤3 | | | |
| | 1995-1999 | M | ≤3 | | | |
| | | F | ≤3 | | | |
| | | B | ≤3 | | | |
| | 2000-2004 | M | ≤3 | | | |
| | | F | ≤3 | | | |
| | | B | ≤3 | | | |
| | 2005-2009 | M | ≤3 | | | |
| | | F | ≤3 | | | |
| | | B | ≤3 | | | |
| | 2010-2014 | M | ≤3 | | | |
| | | F | ≤3 | | | |
| | | B | ≤3 | | | |

**Table A1: Study results by cancer type, analytical period, and gender (continued).**
Analysis of the incidence of primary cancer diagnoses among study area residents between 1980 and 2014 reported to the Utah Cancer Registry by site code. Case counts with '≤3' indicate a stratum with three or fewer cases, resulting in suppression of the results. Case counts with '>3' means the case count was large enough to evaluate, but was suppressed to protect confidential data. Rates are indirect age-standardized incidence rates per 100,000 person-years. The SIRs are the standardized incidence ratios (SIR) with Byar's 99% confidence intervals. Statistical significance is indicated by shading and bold text. Gender codes are "M" for male, "F" for female, and "B" for both genders combined.

| Cancer Site | Analytical Period | Gender | Study Area Cases | Rate | SIR | 99% Confidence Interval |
|---|---|---|---|---|---|---|
| 17 Cutaneous melanoma | 1980-1984 | M | ≤3 | | | |
| | | F | ≤3 | | | |
| | | B | ≤3 | | | |
| | 1985-1989 | M | 4 | 19.19 | 1.39 | 0.22 - 4.39 |
| | | F | 5 | 23.74 | 2.06 | 0.43 - 5.84 |
| | | B | 9 | 21.48 | 1.70 | 0.59 - 3.77 |
| | 1990-1994 | M | >3 | 29.45 | 1.56 | 0.39 - 4.08 |
| | | F | ≤3 | | | |
| | | B | 8 | 19.42 | 1.18 | 0.38 - 2.75 |
| | 1995-1999 | M | >3 | 17.61 | 0.76 | 0.12 - 2.41 |
| | | F | ≤3 | | | |
| | | B | 6 | 13.00 | 0.67 | 0.17 - 1.76 |
| | 2000-2004 | M | 7 | 28.55 | 1.08 | 0.31 - 2.64 |
| | | F | 5 | 19.98 | 1.03 | 0.22 - 2.93 |
| | | B | 12 | 24.22 | 1.06 | 0.43 - 2.13 |
| | 2005-2009 | M | >3 | 31.20 | 0.78 | 0.25 - 1.82 |
| | | F | ≤3 | | | |
| | | B | 11 | 21.66 | 0.67 | 0.26 - 1.38 |
| | 2010-2014 | M | 8 | 29.34 | 0.57 | 0.18 - 1.33 |
| | | F | 5 | 19.24 | 0.58 | 0.12 - 1.65 |
| | | B | 13 | 24.41 | 0.58 | 0.25 - 1.13 |

**Table A1: Study results by cancer type, analytical period, and gender (continued).**
Analysis of the incidence of primary cancer diagnoses among study area residents between 1980 and 2014 reported to the Utah Cancer Registry by site code. Case counts with '≤3' indicate a stratum with three or fewer cases, resulting in suppression of the results. Case counts with '>3' means the case count was large enough to evaluate, but was suppressed to protect confidential data. Rates are indirect age-standardized incidence rates per 100,000 person-years. The SIRs are the standardized incidence ratios (SIR) with Byar's 99% confidence intervals. Statistical significance is indicated by shading and bold text. Gender codes are "M" for male, "F" for female, and "B" for both genders combined.

| Cancer Site | Analytical Period | Gender | Study Area Cases | Rate | SIR | 99% Confidence Interval |
|---|---|---|---|---|---|---|
| 18 Other non-melanoma skin cancer | 1980-1984 | M | ≤3 | | | |
| | | F | ≤3 | | | |
| | | B | ≤3 | | | |
| | 1985-1989 | M | ≤3 | | | |
| | | F | ≤3 | | | |
| | | B | ≤3 | | | |
| | 1990-1994 | M | ≤3 | | | |
| | | F | ≤3 | | | |
| | | B | ≤3 | | | |
| | 1995-1999 | M | ≤3 | | | |
| | | F | ≤3 | | | |
| | | B | ≤3 | | | |
| | 2000-2004 | M | ≤3 | | | |
| | | F | ≤3 | | | |
| | | B | 4 | 8.07 | 3.27 | 0.52 - 10.33 |
| | 2005-2009 | M | ≤3 | | | |
| | | F | ≤3 | | | |
| | | B | ≤3 | | | |
| | 2010-2014 | M | ≤3 | | | |
| | | F | ≤3 | | | |
| | | B | ≤3 | | | |

**Table A1: Study results by cancer type, analytical period, and gender (continued).**
Analysis of the incidence of primary cancer diagnoses among study area residents between 1980 and 2014 reported to the Utah Cancer Registry by site code. Case counts with '≤3' indicate a stratum with three or fewer cases, resulting in suppression of the results. Case counts with '>3' means the case count was large enough to evaluate, but was suppressed to protect confidential data. Rates are indirect age-standardized incidence rates per 100,000 person-years. The SIRs are the standardized incidence ratios (SIR) with Byar's 99% confidence intervals. Statistical significance is indicated by shading and bold text. Gender codes are "M" for male, "F" for female, and "B" for both genders combined.

| Cancer Site | Analytical Period | Gender | Study Area Cases | Rate | SIR | 99% Confidence Interval |
|---|---|---|---|---|---|---|
| 19 Breast | 1980-1984 | F | 16 | 69.29 | 1.03 | 0.49 - 1.90 |
| | 1985-1989 | F | 20 | 94.95 | 1.04 | 0.54 - 1.81 |
| | 1990-1994 | F | 12 | 57.60 | 0.54 | 0.22 - 1.08 |
| | 1995-1999 | F | 27 | 115.17 | 0.97 | 0.56 - 1.57 |
| | 2000-2004 | F | 24 | 95.93 | 0.76 | 0.42 - 1.27 |
| | 2005-2009 | F | 19 | 75.52 | 0.57 | 0.29 - 1.01 |
| | 2010-2014 | F | 47 | 180.87 | 1.26 | 0.84 - 1.81 |

| Cancer Site | Analytical Period | Gender | Study Area Cases | Rate | SIR | 99% Confidence Interval |
|---|---|---|---|---|---|---|
| 20 Cervix | **1980-1984** | **F** | **8** | **34.65** | **5.63** | **1.79 - 13.10** |
| | 1985-1989 | F | ≤3 | | | |
| | 1990-1994 | F | ≤3 | | | |
| | 1995-1999 | F | 6 | 25.59 | 3.80 | 0.95 - 9.93 |
| | 2000-2004 | F | ≤3 | | | |
| | 2005-2009 | F | ≤3 | | | |
| | 2010-2014 | F | ≤3 | | | |

**Table A1: Study results by cancer type, analytical period, and gender (continued).**
Analysis of the incidence of primary cancer diagnoses among study area residents between 1980 and 2014 reported to the Utah Cancer Registry by site code. Case counts with '≤3' indicate a stratum with three or fewer cases, resulting in suppression of the results. Case counts with '>3' means the case count was large enough to evaluate, but was suppressed to protect confidential data. Rates are indirect age-standardized incidence rates per 100,000 person-years. The SIRs are the standardized incidence ratios (SIR) with Byar's 99% confidence intervals. Statistical significance is indicated by shading and bold text. Gender codes are "M" for male, "F" for female, and "B" for both genders combined.

| Cancer Site | Analytical Period | Gender | Study Area Cases | Rate | SIR | 99% Confidence Interval |
|---|---|---|---|---|---|---|
| 21 Uterus | 1980-1984 | F | 7 | 30.32 | 1.51 | 0.43 - 3.70 |
| | 1985-1989 | F | ≤3 | | | |
| | 1990-1994 | F | 7 | 33.60 | 1.30 | 0.37 - 3.19 |
| | 1995-1999 | F | 6 | 25.59 | 1.05 | 0.26 - 2.74 |
| | 2000-2004 | F | 6 | 23.98 | 0.96 | 0.24 - 2.50 |
| | 2005-2009 | F | 10 | 39.75 | 1.37 | 0.50 - 2.93 |
| | 2010-2014 | F | 7 | 26.94 | 0.78 | 0.22 - 1.91 |

| Cancer Site | Analytical Period | Gender | Study Area Cases | Rate | SIR | 99% Confidence Interval |
|---|---|---|---|---|---|---|
| 22 Ovary | 1980-1984 | F | 6 | 25.99 | 2.28 | 0.57 - 5.97 |
| | 1985-1989 | F | ≤3 | | | |
| | 1990-1994 | F | ≤3 | | | |
| | 1995-1999 | F | 5 | 21.33 | 1.56 | 0.33 - 4.43 |
| | 2000-2004 | F | 5 | 19.98 | 1.43 | 0.30 - 4.05 |
| | 2005-2009 | F | ≤3 | | | |
| | 2010-2014 | F | ≤3 | | | |

**Table A1: Study results by cancer type, analytical period, and gender (continued).**
Analysis of the incidence of primary cancer diagnoses among study area residents between 1980 and 2014 reported to the Utah Cancer Registry by site code. Case counts with '≤3' indicate a stratum with three or fewer cases, resulting in suppression of the results. Case counts with '>3' means the case count was large enough to evaluate, but was suppressed to protect confidential data. Rates are indirect age-standardized incidence rates per 100,000 person-years. The SIRs are the standardized incidence ratios (SIR) with Byar's 99% confidence intervals. Statistical significance is indicated by shading and bold text. Gender codes are "M" for male, "F" for female, and "B" for both genders combined.

| Cancer Site | Analytical Period | Gender | Study Area Cases | Rate | SIR | 99% Confidence Interval |
|---|---|---|---|---|---|---|
| 23 Other female genital | 1980-1984 | F | ≤3 | | | |
| | 1985-1989 | F | ≤3 | | | |
| | 1990-1994 | F | ≤3 | | | |
| | 1995-1999 | F | ≤3 | | | |
| | 2000-2004 | F | ≤3 | | | |
| | 2005-2009 | F | ≤3 | | | |
| | 2010-2014 | F | ≤3 | | | |

| Cancer Site | Analytical Period | Gender | Study Area Cases | Rate | SIR | 99% Confidence Interval |
|---|---|---|---|---|---|---|
| 24 Prostate | 1980-1984 | M | 20 | 86.54 | 1.18 | 0.61 - 2.05 |
| | 1985-1989 | M | 16 | 76.78 | 0.74 | 0.35 - 1.36 |
| | 1990-1994 | M | 16 | 78.54 | 0.40 | 0.19 - 0.73 |
| | 1995-1999 | M | 33 | 145.27 | 0.89 | 0.54 - 1.37 |
| | 2000-2004 | M | 42 | 171.30 | 0.95 | 0.61 - 1.40 |
| | 2005-2009 | M | 47 | 183.33 | 0.96 | 0.64 - 1.39 |
| | 2010-2014 | M | 33 | 121.01 | 0.79 | 0.48 - 1.21 |

**Table A1: Study results by cancer type, analytical period, and gender (continued).**
Analysis of the incidence of primary cancer diagnoses among study area residents between 1980 and 2014 reported to the Utah Cancer Registry by site code. Case counts with '≤3' indicate a stratum with three or fewer cases, resulting in suppression of the results. Case counts with '>3' means the case count was large enough to evaluate, but was suppressed to protect confidential data. Rates are indirect age-standardized incidence rates per 100,000 person-years. The SIRs are the standardized incidence ratios (SIR) with Byar's 99% confidence intervals. Statistical significance is indicated by shading and bold text. Gender codes are "M" for male, "F" for female, and "B" for both genders combined.

| Cancer Site | Analytical Period | Gender | Study Area Cases | Rate | SIR | 99% Confidence Interval |
|---|---|---|---|---|---|---|
| 25 Testes | 1980-1984 | M | ≤3 | | | |
| | 1985-1989 | M | ≤3 | | | |
| | 1990-1994 | M | ≤3 | | | |
| | 1995-1999 | M | ≤3 | | | |
| | 2000-2004 | M | ≤3 | | | |
| | 2005-2009 | M | ≤3 | | | |
| | 2010-2014 | M | ≤3 | | | |

| Cancer Site | Analytical Period | Gender | Study Area Cases | Rate | SIR | 99% Confidence Interval |
|---|---|---|---|---|---|---|
| 26 Other male genital | 1980-1984 | M | ≤3 | | | |
| | 1985-1989 | M | ≤3 | | | |
| | 1990-1994 | M | ≤3 | | | |
| | 1995-1999 | M | ≤3 | | | |
| | 2000-2004 | M | ≤3 | | | |
| | 2005-2009 | M | ≤3 | | | |
| | 2010-2014 | M | ≤3 | | | |

**Table A1: Study results by cancer type, analytical period, and gender (continued).**
Analysis of the incidence of primary cancer diagnoses among study area residents between 1980 and 2014 reported to the Utah Cancer Registry by site code. Case counts with '≤3' indicate a stratum with three or fewer cases, resulting in suppression of the results. Case counts with '>3' means the case count was large enough to evaluate, but was suppressed to protect confidential data. Rates are indirect age-standardized incidence rates per 100,000 person-years. The SIRs are the standardized incidence ratios (SIR) with Byar's 99% confidence intervals. Statistical significance is indicated by shading and bold text. Gender codes are "M" for male, "F" for female, and "B" for both genders combined.

| Cancer Site | Analytical Period | Gender | Study Area Cases | Rate | SIR | 99% Confidence Interval |
|---|---|---|---|---|---|---|
| 27 Bladder | 1980-1984 | M | >3 | 17.31 | 1.04 | 0.17 - 3.30 |
| | | F | ≤3 | | | |
| | | B | 5 | 10.82 | 1.04 | 0.22 - 2.96 |
| | 1985-1989 | M | >3 | 33.59 | 1.56 | 0.45 - 3.84 |
| | | F | ≤3 | | | |
| | | B | 8 | 19.09 | 1.47 | 0.47 - 3.41 |
| | 1990-1994 | M | >3 | 19.64 | 0.84 | 0.13 - 2.65 |
| | | F | ≤3 | | | |
| | | B | >3 | 9.71 | 0.67 | 0.11 - 2.12 |
| | 1995-1999 | M | >3 | 30.81 | 1.12 | 0.32 - 2.74 |
| | | F | ≤3 | | | |
| | | B | 10 | 21.66 | 1.26 | 0.46 - 2.69 |
| | 2000-2004 | M | 4 | 16.31 | 0.61 | 0.10 - 1.93 |
| | | F | 4 | 15.99 | 2.32 | 0.37 - 7.31 |
| | | B | 8 | 16.15 | 0.97 | 0.31 - 2.25 |
| | 2005-2009 | M | >3 | 15.60 | 0.53 | 0.08 - 1.66 |
| | | F | ≤3 | | | 0.18 - 6.65 |
| | | B | 7 | 13.78 | 0.76 | 0.22 - 1.86 |
| | 2010-2014 | M | >3 | 33.00 | 1.10 | 0.38 - 2.46 |
| | | F | ≤3 | | | |
| | | B | 10 | 18.78 | 1.00 | 0.37 - 2.13 |

**Table A1: Study results by cancer type, analytical period, and gender (continued).**
Analysis of the incidence of primary cancer diagnoses among study area residents between 1980 and 2014 reported to the Utah Cancer Registry by site code. Case counts with '≤3' indicate a stratum with three or fewer cases, resulting in suppression of the results. Case counts with '>3' means the case count was large enough to evaluate, but was suppressed to protect confidential data. Rates are indirect age-standardized incidence rates per 100,000 person-years. The SIRs are the standardized incidence ratios (SIR) with Byar's 99% confidence intervals. Statistical significance is indicated by shading and bold text. Gender codes are "M" for male, "F" for female, and "B" for both genders combined.

| Cancer Site | Analytical Period | Gender | Study Area Cases | Rate | SIR | 99% Confidence Interval |
|---|---|---|---|---|---|---|
| 28 Kidney & renal pelvis | 1980-1984 | M | ≤3 | | | |
| | | F | ≤3 | | | |
| | | B | ≤3 | | | |
| | 1985-1989 | M | ≤3 | | | |
| | | F | ≤3 | | | |
| | | B | ≤3 | | | |
| | 1990-1994 | M | ≤3 | | | |
| | | F | ≤3 | | | |
| | | B | ≤3 | | | |
| | 1995-1999 | M | >3 | 22.01 | 2.14 | 0.45 - 6.07 |
| | | F | ≤3 | | | |
| | | B | 5 | 10.83 | 1.34 | 0.28 - 3.79 |
| | 2000-2004 | M | >3 | 16.31 | 1.25 | 0.20 - 3.93 |
| | | F | ≤3 | | | |
| | | B | 6 | 12.11 | 1.13 | 0.28 - 2.95 |
| | 2005-2009 | M | ≤3 | | | |
| | | F | >3 | 15.90 | 1.50 | 0.24 - 4.73 |
| | | B | 7 | 13.78 | 1.04 | 0.30 - 2.55 |
| | 2010-2014 | M | 5 | 18.34 | 0.88 | 0.18 - 2.49 |
| | | F | 4 | 15.39 | 1.29 | 0.21 - 4.08 |
| | | B | 9 | 16.90 | 1.02 | 0.35 - 2.28 |

**Table A1: Study results by cancer type, analytical period, and gender (continued).**
Analysis of the incidence of primary cancer diagnoses among study area residents between 1980 and 2014 reported to the Utah Cancer Registry by site code. Case counts with '≤3' indicate a stratum with three or fewer cases, resulting in suppression of the results. Case counts with '>3' means the case count was large enough to evaluate, but was suppressed to protect confidential data. Rates are indirect age-standardized incidence rates per 100,000 person-years. The SIRs are the standardized incidence ratios (SIR) with Byar's 99% confidence intervals. Statistical significance is indicated by shading and bold text. Gender codes are "M" for male, "F" for female, and "B" for both genders combined.

| Cancer Site | Analytical Period | Gender | Study Area Cases | Rate | SIR | 99% Confidence Interval |
|---|---|---|---|---|---|---|
| 29 Other urinary | 1980-1984 | M | ≤3 | | | |
| | | F | ≤3 | | | |
| | | B | ≤3 | | | |
| | 1985-1989 | M | ≤3 | | | |
| | | F | ≤3 | | | |
| | | B | ≤3 | | | |
| | 1990-1994 | M | ≤3 | | | |
| | | F | ≤3 | | | |
| | | B | ≤3 | | | |
| | 1995-1999 | M | ≤3 | | | |
| | | F | ≤3 | | | |
| | | B | ≤3 | | | |
| | 2000-2004 | M | ≤3 | | | |
| | | F | ≤3 | | | |
| | | B | ≤3 | | | |
| | 2005-2009 | M | ≤3 | | | |
| | | F | ≤3 | | | |
| | | B | ≤3 | | | |
| | 2010-2014 | M | ≤3 | | | |
| | | F | ≤3 | | | |
| | | B | ≤3 | | | |

**Table A1: Study results by cancer type, analytical period, and gender (continued).**
Analysis of the incidence of primary cancer diagnoses among study area residents between 1980 and 2014 reported to the Utah Cancer Registry by site code. Case counts with '≤3' indicate a stratum with three or fewer cases, resulting in suppression of the results. Case counts with '>3' means the case count was large enough to evaluate, but was suppressed to protect confidential data. Rates are indirect age-standardized incidence rates per 100,000 person-years. The SIRs are the standardized incidence ratios (SIR) with Byar's 99% confidence intervals. Statistical significance is indicated by shading and bold text. Gender codes are "M" for male, "F" for female, and "B" for both genders combined.

| Cancer Site | Analytical Period | Gender | Study Area Cases | Rate | SIR | 99% Confidence Interval |
|---|---|---|---|---|---|---|
| 30 Eye & orbit | 1980-1984 | M | ≤3 | | | |
| | | F | ≤3 | | | |
| | | B | ≤3 | | | |
| | 1985-1989 | M | ≤3 | | | |
| | | F | ≤3 | | | |
| | | B | ≤3 | | | |
| | 1990-1994 | M | ≤3 | | | |
| | | F | ≤3 | | | |
| | | B | ≤3 | | | |
| | 1995-1999 | M | ≤3 | | | |
| | | F | ≤3 | | | |
| | | B | ≤3 | | | |
| | 2000-2004 | M | ≤3 | | | |
| | | F | ≤3 | | | |
| | | B | ≤3 | | | |
| | 2005-2009 | M | ≤3 | | | |
| | | F | ≤3 | | | |
| | | B | ≤3 | | | |
| | 2010-2014 | M | ≤3 | | | |
| | | F | ≤3 | | | |
| | | B | ≤3 | | | |

**Table A1: Study results by cancer type, analytical period, and gender (continued).**
Analysis of the incidence of primary cancer diagnoses among study area residents between 1980 and 2014 reported to the Utah Cancer Registry by site code. Case counts with '≤3' indicate a stratum with three or fewer cases, resulting in suppression of the results. Case counts with '>3' means the case count was large enough to evaluate, but was suppressed to protect confidential data. Rates are indirect age-standardized incidence rates per 100,000 person-years. The SIRs are the standardized incidence ratios (SIR) with Byar's 99% confidence intervals. Statistical significance is indicated by shading and bold text. Gender codes are "M" for male, "F" for female, and "B" for both genders combined.

| Cancer Site | Analytical Period | Gender | Study Area Cases | Rate | SIR | 99% Confidence Interval |
|---|---|---|---|---|---|---|
| 31 Brain | 1980-1984 | M | ≤3 | | | |
| | | F | ≤3 | | | |
| | | B | ≤3 | | | |
| | 1985-1989 | M | ≤3 | | | |
| | | F | ≤3 | | | |
| | | B | ≤3 | | | |
| | 1990-1994 | M | ≤3 | | | |
| | | F | ≤3 | | | |
| | | B | 5 | 12.14 | 1.92 | 0.40 - 5.44 |
| | 1995-1999 | M | ≤3 | | | |
| | | F | ≤3 | | | |
| | | B | 4 | 8.67 | 1.26 | 0.20 - 3.98 |
| | 2000-2004 | M | ≤3 | | | |
| | | F | ≤3 | | | |
| | | B | ≤3 | | | |
| | 2005-2009 | M | ≤3 | | | |
| | | F | ≤3 | | | |
| | | B | 4 | 7.87 | 1.12 | 0.18 - 3.54 |
| | 2010-2014 | M | ≤3 | | | |
| | | F | ≤3 | | | |
| | | B | ≤3 | | | |

**Table A1: Study results by cancer type, analytical period, and gender (continued).**
Analysis of the incidence of primary cancer diagnoses among study area residents between 1980 and 2014 reported to the Utah Cancer Registry by site code. Case counts with '≤3' indicate a stratum with three or fewer cases, resulting in suppression of the results. Case counts with '>3' means the case count was large enough to evaluate, but was suppressed to protect confidential data. Rates are indirect age-standardized incidence rates per 100,000 person-years. The SIRs are the standardized incidence ratios (SIR) with Byar's 99% confidence intervals. Statistical significance is indicated by shading and bold text. Gender codes are "M" for male, "F" for female, and "B" for both genders combined.

| Cancer Site | Analytical Period | Gender | Study Area Cases | Rate | SIR | 99% Confidence Interval |
|---|---|---|---|---|---|---|
| 32 Other central nervous system | 1980-1984 | M | ≤3 | | | |
| | | F | ≤3 | | | |
| | | B | ≤3 | | | |
| | 1985-1989 | M | ≤3 | | | |
| | | F | ≤3 | | | |
| | | B | ≤3 | | | |
| | 1990-1994 | M | ≤3 | | | |
| | | F | ≤3 | | | |
| | | B | ≤3 | | | |
| | 1995-1999 | M | ≤3 | | | |
| | | F | ≤3 | | | |
| | | B | ≤3 | | | |
| | 2000-2004 | M | ≤3 | | | |
| | | F | ≤3 | | | |
| | | B | ≤3 | | | |
| | 2005-2009 | M | ≤3 | | | |
| | | F | ≤3 | | | |
| | | B | ≤3 | | | |
| | 2010-2014 | M | ≤3 | | | |
| | | F | ≤3 | | | |
| | | B | ≤3 | | | |

**Table A1: Study results by cancer type, analytical period, and gender (continued).**
Analysis of the incidence of primary cancer diagnoses among study area residents between 1980 and 2014 reported to the Utah Cancer Registry by site code. Case counts with '≤3' indicate a stratum with three or fewer cases, resulting in suppression of the results. Case counts with '>3' means the case count was large enough to evaluate, but was suppressed to protect confidential data. Rates are indirect age-standardized incidence rates per 100,000 person-years. The SIRs are the standardized incidence ratios (SIR) with Byar's 99% confidence intervals. Statistical significance is indicated by shading and bold text. Gender codes are "M" for male, "F" for female, and "B" for both genders combined.

| Cancer Site | Analytical Period | Gender | Study Area Cases | Rate | SIR | 99% Confidence Interval |
|---|---|---|---|---|---|---|
| 33 Thyroid | 1980-1984 | M | ≤3 | | | |
| | | F | ≤3 | | | |
| | | B | ≤3 | | | |
| | 1985-1989 | M | ≤3 | | | |
| | | F | ≤3 | | | |
| | | B | ≤3 | | | |
| | 1990-1994 | M | ≤3 | | | |
| | | F | ≤3 | | | |
| | | B | ≤3 | | | |
| | 1995-1999 | M | ≤3 | | | |
| | | F | ≤3 | | | |
| | | B | ≤3 | | | |
| | 2000-2004 | M | ≤3 | | | |
| | | F | ≤3 | | | |
| | | B | 5 | 10.09 | 0.92 | 0.19 - 2.62 |
| | 2005-2009 | M | ≤3 | | | |
| | | F | ≤3 | | | |
| | | B | ≤3 | | | |
| | 2010-2014 | M | ≤3 | | | |
| | | F | >3 | 19.24 | 0.59 | 0.12 - 1.68 |
| | | B | 5 | 9.39 | 0.44 | 0.09 - 1.26 |

**Table A1: Study results by cancer type, analytical period, and gender (continued).**
Analysis of the incidence of primary cancer diagnoses among study area residents between 1980 and 2014 reported to the Utah Cancer Registry by site code. Case counts with '≤3' indicate a stratum with three or fewer cases, resulting in suppression of the results. Case counts with '>3' means the case count was large enough to evaluate, but was suppressed to protect confidential data. Rates are indirect age-standardized incidence rates per 100,000 person-years. The SIRs are the standardized incidence ratios (SIR) with Byar's 99% confidence intervals. Statistical significance is indicated by shading and bold text. Gender codes are "M" for male, "F" for female, and "B" for both genders combined.

| Cancer Site | Analytical Period | Gender | Study Area Cases | Rate | SIR | 99% Confidence Interval |
|---|---|---|---|---|---|---|
| 34 Other endocrine | 1980-1984 | M | ≤3 | | | |
| | | F | ≤3 | | | |
| | | B | ≤3 | | | |
| | 1985-1989 | M | ≤3 | | | |
| | | F | ≤3 | | | |
| | | B | ≤3 | | | |
| | 1990-1994 | M | ≤3 | | | |
| | | F | ≤3 | | | |
| | | B | ≤3 | | | |
| | 1995-1999 | M | ≤3 | | | |
| | | F | ≤3 | | | |
| | | B | ≤3 | | | |
| | 2000-2004 | M | ≤3 | | | |
| | | F | ≤3 | | | |
| | | B | ≤3 | | | |
| | 2005-2009 | M | ≤3 | | | |
| | | F | ≤3 | | | |
| | | B | ≤3 | | | |
| | 2010-2014 | M | ≤3 | | | |
| | | F | ≤3 | | | |
| | | B | ≤3 | | | |

**Table A1: Study results by cancer type, analytical period, and gender (continued).**
Analysis of the incidence of primary cancer diagnoses among study area residents between 1980 and 2014 reported to the Utah Cancer Registry by site code. Case counts with '≤3' indicate a stratum with three or fewer cases, resulting in suppression of the results. Case counts with '>3' means the case count was large enough to evaluate, but was suppressed to protect confidential data. Rates are indirect age-standardized incidence rates per 100,000 person-years. The SIRs are the standardized incidence ratios (SIR) with Byar's 99% confidence intervals. Statistical significance is indicated by shading and bold text. Gender codes are "M" for male, "F" for female, and "B" for both genders combined.

| Cancer Site | Analytical Period | Gender | Study Area Cases | Rate | SIR | 99% Confidence Interval |
|---|---|---|---|---|---|---|
| 35 Hodgkin's lymphoma | 1980-1984 | M | ≤3 | | | |
| | | F | ≤3 | | | |
| | | B | ≤3 | | | |
| | 1985-1989 | M | ≤3 | | | |
| | | F | ≤3 | | | |
| | | B | ≤3 | | | |
| | 1990-1994 | M | ≤3 | | | |
| | | F | ≤3 | | | |
| | | B | ≤3 | | | |
| | 1995-1999 | M | ≤3 | | | |
| | | F | ≤3 | | | |
| | | B | ≤3 | | | |
| | 2000-2004 | M | ≤3 | | | |
| | | F | ≤3 | | | |
| | | B | ≤3 | | | |
| | 2005-2009 | M | ≤3 | | | |
| | | F | ≤3 | | | |
| | | B | ≤3 | | | |
| | 2010-2014 | M | ≤3 | | | |
| | | F | ≤3 | | | |
| | | B | ≤3 | | | |

**Table A1: Study results by cancer type, analytical period, and gender (continued).**
Analysis of the incidence of primary cancer diagnoses among study area residents between 1980 and 2014 reported to the Utah Cancer Registry by site code. Case counts with '≤3' indicate a stratum with three or fewer cases, resulting in suppression of the results. Case counts with '>3' means the case count was large enough to evaluate, but was suppressed to protect confidential data. Rates are indirect age-standardized incidence rates per 100,000 person-years. The SIRs are the standardized incidence ratios (SIR) with Byar's 99% confidence intervals. Statistical significance is indicated by shading and bold text. Gender codes are "M" for male, "F" for female, and "B" for both genders combined.

| Cancer Site | Analytical Period | Gender | Study Area Cases | Rate | SIR | 99% Confidence Interval |
|---|---|---|---|---|---|---|
| 36 Non-Hodgkin's lymphoma | 1980-1984 | M | ≤3 | | | |
| | | F | ≤3 | | | |
| | | B | ≤3 | | | |
| | 1985-1989 | M | ≤3 | | | |
| | | F | ≤3 | | | |
| | | B | 4 | 9.55 | 0.79 | 0.13 - 2.49 |
| | 1990-1994 | M | ≤3 | | | |
| | | F | ≤3 | | | |
| | | B | ≤3 | | | |
| | 1995-1999 | M | ≤3 | | | |
| | | F | ≤3 | | | |
| | | B | ≤3 | | | |
| | 2000-2004 | M | >3 | 24.47 | 1.12 | 0.28 - 2.92 |
| | | F | ≤3 | | | |
| | | B | 9 | 18.17 | 0.94 | 0.32 - 2.09 |
| | 2005-2009 | M | >3 | 19.50 | 0.80 | 0.17 - 2.26 |
| | | F | ≤3 | | | |
| | | B | 7 | 13.78 | 0.64 | 0.18 - 1.56 |
| | 2010-2014 | M | 5 | 18.34 | 0.75 | 0.16 - 2.11 |
| | | F | 6 | 23.09 | 1.24 | 0.31 - 3.24 |
| | | B | 11 | 20.66 | 0.95 | 0.37 - 1.97 |

**Table A1: Study results by cancer type, analytical period, and gender (continued).**
Analysis of the incidence of primary cancer diagnoses among study area residents between 1980 and 2014 reported to the Utah Cancer Registry by site code. Case counts with '≤3' indicate a stratum with three or fewer cases, resulting in suppression of the results. Case counts with '>3' means the case count was large enough to evaluate, but was suppressed to protect confidential data. Rates are indirect age-standardized incidence rates per 100,000 person-years. The SIRs are the standardized incidence ratios (SIR) with Byar's 99% confidence intervals. Statistical significance is indicated by shading and bold text. Gender codes are "M" for male, "F" for female, and "B" for both genders combined.

| Cancer Site | Analytical Period | Gender | Study Area Cases | Rate | SIR | 99% Confidence Interval |
|---|---|---|---|---|---|---|
| 37 Multiple myeloma | 1980-1984 | M | ≤3 | | | |
| | | F | ≤3 | | | |
| | | B | ≤3 | | | |
| | 1985-1989 | M | ≤3 | | | |
| | | F | ≤3 | | | |
| | | B | ≤3 | | | |
| | 1990-1994 | M | ≤3 | | | |
| | | F | ≤3 | | | |
| | | B | ≤3 | | | |
| | 1995-1999 | M | ≤3 | | | |
| | | F | ≤3 | | | |
| | | B | ≤3 | | | |
| | 2000-2004 | M | ≤3 | | | |
| | | F | ≤3 | | | |
| | | B | ≤3 | | | |
| | 2005-2009 | M | ≤3 | | | |
| | | F | ≤3 | | | |
| | | B | ≤3 | | | |
| | 2010-2014 | M | ≤3 | | | |
| | | F | ≤3 | | | |
| | | B | ≤3 | | | |

**Table A1: Study results by cancer type, analytical period, and gender (continued).**
Analysis of the incidence of primary cancer diagnoses among study area residents between 1980 and 2014 reported to the Utah Cancer Registry by site code. Case counts with '≤3' indicate a stratum with three or fewer cases, resulting in suppression of the results. Case counts with '>3' means the case count was large enough to evaluate, but was suppressed to protect confidential data. Rates are indirect age-standardized incidence rates per 100,000 person-years. The SIRs are the standardized incidence ratios (SIR) with Byar's 99% confidence intervals. Statistical significance is indicated by shading and bold text. Gender codes are "M" for male, "F" for female, and "B" for both genders combined.

| Cancer Site | Analytical Period | Gender | Study Area Cases | Rate | SIR | 99% Confidence Interval |
|---|---|---|---|---|---|---|
| 38 Lymphocytic leukemia | 1980-1984 | M | ≤3 | | | |
| | | F | ≤3 | | | |
| | | B | ≤3 | | | |
| | 1985-1989 | M | ≤3 | | | |
| | | F | ≤3 | | | |
| | | B | ≤3 | | | |
| | 1990-1994 | M | ≤3 | | | |
| | | F | ≤3 | | | |
| | | B | ≤3 | | | |
| | 1995-1999 | M | ≤3 | | | |
| | | F | ≤3 | | | |
| | | B | 5 | 10.83 | 2.07 | 0.43 - 5.88 |
| | 2000-2004 | M | ≤3 | | | |
| | | F | ≤3 | | | |
| | | B | ≤3 | | | |
| | 2005-2009 | M | >3 | 15.60 | 1.58 | 0.25 - 4.98 |
| | | F | ≤3 | | | |
| | | B | 6 | 11.81 | 1.47 | 0.37 - 3.83 |
| | 2010-2014 | M | ≤3 | | | 0.11 - 3.96 |
| | | F | ≤3 | | | |
| | | B | 5 | 9.39 | 1.16 | 0.24 - 3.28 |

**Table A1: Study results by cancer type, analytical period, and gender (continued).**
Analysis of the incidence of primary cancer diagnoses among study area residents between 1980 and 2014 reported to the Utah Cancer Registry by site code. Case counts with '≤3' indicate a stratum with three or fewer cases, resulting in suppression of the results. Case counts with '>3' means the case count was large enough to evaluate, but was suppressed to protect confidential data. Rates are indirect age-standardized incidence rates per 100,000 person-years. The SIRs are the standardized incidence ratios (SIR) with Byar's 99% confidence intervals. Statistical significance is indicated by shading and bold text. Gender codes are "M" for male, "F" for female, and "B" for both genders combined.

| Cancer Site | Analytical Period | Gender | Study Area Cases | Rate | SIR | 99% Confidence Interval |
|---|---|---|---|---|---|---|
| 39 Myeloid leukemia | 1980-1984 | M | ≤3 | | | |
| | | F | ≤3 | | | |
| | | B | ≤3 | | | |
| | 1985-1989 | M | ≤3 | | | |
| | | F | ≤3 | | | |
| | | B | ≤3 | | | |
| | 1990-1994 | M | ≤3 | | | |
| | | F | ≤3 | | | |
| | | B | ≤3 | | | |
| | 1995-1999 | M | ≤3 | | | |
| | | F | ≤3 | | | |
| | | B | ≤3 | | | |
| | 2000-2004 | M | ≤3 | | | |
| | | F | ≤3 | | | |
| | | B | ≤3 | | | |
| | 2005-2009 | M | ≤3 | | | |
| | | F | ≤3 | | | |
| | | B | ≤3 | | | |
| | 2010-2014 | M | ≤3 | | | |
| | | F | ≤3 | | | |
| | | B | ≤3 | | | |

**Table A1: Study results by cancer type, analytical period, and gender (continued).**
Analysis of the incidence of primary cancer diagnoses among study area residents between 1980 and 2014 reported to the Utah Cancer Registry by site code. Case counts with '≤3' indicate a stratum with three or fewer cases, resulting in suppression of the results. Case counts with '>3' means the case count was large enough to evaluate, but was suppressed to protect confidential data. Rates are indirect age-standardized incidence rates per 100,000 person-years. The SIRs are the standardized incidence ratios (SIR) with Byar's 99% confidence intervals. Statistical significance is indicated by shading and bold text. Gender codes are "M" for male, "F" for female, and "B" for both genders combined.

| Cancer Site | Analytical Period | Gender | Study Area Cases | Rate | SIR | 99% Confidence Interval |
|---|---|---|---|---|---|---|
| 40 Monocytic leukemia | 1980-1984 | M | ≤3 | | | |
| | | F | ≤3 | | | |
| | | B | ≤3 | | | |
| | 1985-1989 | M | ≤3 | | | |
| | | F | ≤3 | | | |
| | | B | ≤3 | | | |
| | 1990-1994 | M | ≤3 | | | |
| | | F | ≤3 | | | |
| | | B | ≤3 | | | |
| | 1995-1999 | M | ≤3 | | | |
| | | F | ≤3 | | | |
| | | B | ≤3 | | | |
| | 2000-2004 | M | ≤3 | | | |
| | | F | ≤3 | | | |
| | | B | ≤3 | | | |
| | 2005-2009 | M | ≤3 | | | |
| | | F | ≤3 | | | |
| | | B | ≤3 | | | |
| | 2010-2014 | M | ≤3 | | | |
| | | F | ≤3 | | | |
| | | B | ≤3 | | | |

**Table A1: Study results by cancer type, analytical period, and gender (continued).**
Analysis of the incidence of primary cancer diagnoses among study area residents between 1980 and 2014 reported to the Utah Cancer Registry by site code. Case counts with '≤3' indicate a stratum with three or fewer cases, resulting in suppression of the results. Case counts with '>3' means the case count was large enough to evaluate, but was suppressed to protect confidential data. Rates are indirect age-standardized incidence rates per 100,000 person-years. The SIRs are the standardized incidence ratios (SIR) with Byar's 99% confidence intervals. Statistical significance is indicated by shading and bold text. Gender codes are "M" for male, "F" for female, and "B" for both genders combined.

| Cancer Site | Analytical Period | Gender | Study Area Cases | Rate | SIR | 99% Confidence Interval |
|---|---|---|---|---|---|---|
| 41 Other leukemia | 1980-1984 | M | ≤3 | | | |
| | | F | ≤3 | | | |
| | | B | ≤3 | | | |
| | 1985-1989 | M | ≤3 | | | |
| | | F | ≤3 | | | |
| | | B | ≤3 | | | |
| | 1990-1994 | M | ≤3 | | | |
| | | F | ≤3 | | | |
| | | B | ≤3 | | | |
| | 1995-1999 | M | ≤3 | | | |
| | | F | ≤3 | | | |
| | | B | ≤3 | | | |
| | 2000-2004 | M | ≤3 | | | |
| | | F | ≤3 | | | |
| | | B | ≤3 | | | |
| | 2005-2009 | M | ≤3 | | | |
| | | F | ≤3 | | | |
| | | B | ≤3 | | | |
| | 2010-2014 | M | ≤3 | | | |
| | | F | ≤3 | | | |
| | | B | ≤3 | | | |

**Table A1: Study results by cancer type, analytical period, and gender (continued).**
Analysis of the incidence of primary cancer diagnoses among study area residents between 1980 and 2014 reported to the Utah Cancer Registry by site code. Case counts with '≤3' indicate a stratum with three or fewer cases, resulting in suppression of the results. Case counts with '>3' means the case count was large enough to evaluate, but was suppressed to protect confidential data. Rates are indirect age-standardized incidence rates per 100,000 person-years. The SIRs are the standardized incidence ratios (SIR) with Byar's 99% confidence intervals. Statistical significance is indicated by shading and bold text. Gender codes are "M" for male, "F" for female, and "B" for both genders combined.

| Cancer Site | Analytical Period | Gender | Study Area Cases | Rate | SIR | 99% Confidence Interval |
|---|---|---|---|---|---|---|
| 42 Other sites & types | 1980-1984 | M | ≤3 | | | |
| | | F | ≤3 | | | |
| | | B | ≤3 | | | |
| | 1985-1989 | M | >3 | 19.19 | 2.14 | 0.34 - 6.76 |
| | | F | ≤3 | | | |
| | | B | >3 | 9.55 | 1.15 | 0.18 - 3.63 |
| | 1990-1994 | M | ≤3 | | | |
| | | F | ≤3 | | | |
| | | B | ≤3 | | | |
| | 1995-1999 | M | ≤3 | | | |
| | | F | ≤3 | | | |
| | | B | ≤3 | | | |
| | 2000-2004 | M | 6 | 24.47 | 2.00 | 0.50 - 5.24 |
| | | F | 6 | 23.98 | 2.20 | 0.55 - 5.74 |
| | | B | 12 | 24.22 | 2.09 | 0.86 - 4.22 |
| | 2005-2009 | M | >3 | 15.60 | 1.09 | 0.18 - 3.45 |
| | | F | ≤3 | | | |
| | | B | 5 | 9.84 | 0.73 | 0.15 - 2.06 |
| | 2010-2014 | M | 6 | 22.00 | 1.52 | 0.38 - 3.97 |
| | | F | 8 | 30.79 | 2.42 | 0.77 - 5.63 |
| | | B | 14 | 26.29 | 1.93 | 0.86 - 3.70 |

**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/.

**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/.

**CI** Confidence interval. Because there is some error in estimating a population parameter, and that error increases as the population size decreases, a confidence interval is used to indicate the degree of uncertainty associated with a parameter estimate. It is important to remember that a CI of a particular level (for example, a 99% confidence interval) does not refer to a specific calculated interval. Rather, the 99% probability relates to the reliability of the estimation procedure. Once a study is done and a CI calculated, the interval either covers the true parameter value or it does not (i.e., the probability is either 100% or 0%).

**CIS** Carcinoma in-situ is an early form of cancer that is defined by the absence of invasion of tumor cells into the surrounding tissue. Instead, the lesion is flat or follows the existing architecture of the organ. In this state, CIS seldom cause clinical systems sufficient to prompt the person with CIS to seek medical assistance and are generally undetected. CIS can progress to invasive tumors and are therefore considered a precursor or incipient form of cancer.

**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/.

**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 five-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 QGIS as the computer software, and obtains data from 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/.

**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: www.cancer.gov/publications/dictionaries/cancer-terms/def/incidence.

**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/.

**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: www.cancer.gov/publications/dictionaries/cancer-terms/def/prevalence.

**QGIS** A complete, open source GIS software application for producing maps and viewing, editing, and analyzing geospatial data. In this study, the EEP used version 2.18.10. For more information, see: www.qgis.org.

**R** R is a globally recognized system of integrated open source computer software products provided by the Comprehensive R Archive Network (CRAN). The application is developed using a collaboration of contributing developers with expertise in a variety of fields, including epidemiology and public health statistics. The R application includes a large variety of data manipulation and statistical analysis methodologies. In this study, the EEP used version 3.4.1. For more information, see: https://cran.r-project.org.

**Rate** Sometimes called an 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: www.cancer.gov/publications/dictionaries/cancer-terms/def/incidence.

**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/.

**SEUHD** Southeast Utah Health Department. One of the 13 local health departments with public health jurisdiction in Utah. SEUHD provides public health services to residents within Carbon, Emery, and Grand Counties. For more information, see: http://www.seuhealth.com or call (435) 637-3671.

**SIR** Standardized incidence ratio. See the **Formulas** section below for an in depth explanation.

**Standardized** See the **Formulas** section below for an in-depth explanation.

**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/.

**Resources**

| | |
|---|---|
| American Cancer Society: | www.cancer.org/cancer/ovarian-cancer |
| American Society of Clinical Oncology: | www.cancer.net/cancer-types/ovarian-cancer |
| Huntsman Cancer Institute: | healthcare.utah.edu/huntsmancancerinstitute/cancer-information/cancer-types-and-topics/ovarian-cancer.php |
| Intermountain Healthcare Cancer Services: | intermountainhealthcare.org/services/cancer/Pages/home.aspx |
| National Cancer Institute: | www.cancer.gov |
| UDOH Cancer Control Program: | cancerutah.org |
| UDOH Tobacco Prevention and Control Program | www.tobaccofreeutah.org |
| Utah Radon Program (including discounted tests) | deq.utah.gov/ProgramsServices/programs/radiation/radon |
| Utah Cancer Action Network: | www.ucan.cc |
| Utah Cancer Specialists: | www.utahcancer.com |