Cancer Incidence in Silver Bow County, Montana, 1979-1999

Introduction

In June 2001, the Montana Department of Public Health and Human Services (MDPHHS) requested that the Agency for Toxic Substances and Disease Registry (ATSDR) evaluate cancer incidence data for Silver Bow County. The MDPHHS and Silver Bow County Health Department have had reports of possible cancer excesses from residents and physicians in the area for many years. This analysis focused on cancer outcomes associated with potential exposure to heavy metals including arsenic, and, to a lesser extent, lead and mercury.

Historically, elevated environmental levels of numerous heavy metals have been found in Silver Bow County soils as a result of mining practices in the area. The Silver Bow Creek/Butte Area National Priorities List (NPL) site is an extensively contaminated site located in Silver Bow and Deer Lodge Counties. ATSDR has issued numerous documents related to this NPL site including health assessments, site review and updates, and health consultations. The agency has also conducted various health studies and exposure investigations in the Silver Bow area.

The purpose of this data review is to compare cancer incidence rates from Silver Bow County with similar data at the State and national levels. This ecologic analysis does not include any exposure information. Instead, it relies solely on cancer incidence data from state and national cancer registries and population demographic data from the U.S. Census Bureau.

Materials/Methods

The Montana Central Tumor Registry provided cancer incidence data to ATSDR in the summer of 2001. This data described all newly diagnosed cases occurring in Silver Bow County and the entire state of Montana during the twenty-one year period from 1979 to 1999. Specific cancer sites analyzed included the urinary bladder, kidney, liver, lung, prostate, and skin. Skin cancers used in this analysis included malignant melanomas as well as nonmelanomas. These outcomes were chosen because of their reported associations with arsenic exposure. Mercury is not considered a human carcinogen and therefore did not influence the choice of cancers being analyzed. There is limited information on the potential for lead to cause cancer so this contaminant also had little influence on the cancer sites analyzed.

Standardized incidence ratios (SIRs) were calculated using two comparison groups. The comparison groups included the entire state of Montana and a representative portion of the United States population. The Montana Central Tumor Registry provided cancer

incidence data for the state of Montana for the years 1979 to 1999. Cancer incidence data for the United States were obtained from the National Cancer Institute's (NCI) Surveillance, Epidemiology, and End Results (SEER) program. The SEER program collects and publishes cancer incidence and survival data from 11 population-based cancer registries and three supplemental registries covering approximately 14 percent of the U.S. population. The SEER data used for comparison in this analysis included cancer incidence from 1989 to 1998.

Cancer incidence data for Silver Bow County and the two comparison populations were standardized using four age groupings; 20-54, 55-64, 65-74, and 75 and over. These predefined age groupings are used in publicly available SEER datasets. Age standardization eliminated the effects of age differences among residents of Silver Bow County, the state of Montana, and the United States as a whole. Cancer incidence rates for the state of Montana were adjusted using 1990 Census Bureau data. United States (SEER) incidence data were adjusted using the standard 1970 U.S. population.

Results

Skin cancer was the only outcome that demonstrated elevated rates when compared to both Montana and U.S. reference populations (Table 1, Table 2). The SIR for all persons age 20 and over when compared to the state of Montana was 1.23 (95% CI, 1.04-1.44) and compared to the U.S. population was 1.24 (95% CI, 1.05-1.45). There were also elevated SIRs within multiple age-specific categories for skin cancer when compared with both reference populations.

Other cancer outcomes including urinary bladder, kidney, and lung demonstrated elevated rates in some age-specific categories but these elevations were not consistent when compared with both reference populations. Liver and prostate cancer rates were not elevated when compared with either reference population.

Discussion

A previous ecologic analysis of skin cancer rates in Silver Bow County and neighboring Deer Lodge County by Otto et al. failed to show any significant increases in cancer morbidity. However, their analysis used only six and a half years of cancer incidence data (1980 to mid-1986) and this analysis looked at cancer incidence over a much longer time frame (1979-1999). Otto et al. identified all skin cancer cases through pathologists and dermatologists in the area, a less effective method compared with the use of data obtained from the state's central tumor registry. Case ascertainment in this analysis should be significantly increased through the use of registry data.

There are numerous limitations to this ecologic analysis including the potential for in- and out-migration of cases, a lack of exposure data, and no assessment of temporal variables (i.e. were subjects exposed before the occurrence of disease and were these

Table 2 **Standardized Incidence Ratios using the U.S. population (SEER) as a Reference, 1979-1999**

Urinary Bladder

Age Categories	Observed	Expected	SIR	Lower 95% CI	Upper 95% CI
20-54	1	15.2	0.07	0.00	0.37
55-64	18	28.5	0.60	0.37	1.00
65-74	90	62.8	**1.40¶**	1.15	1.76
75+	68	76.3	0.89	0.69	1.13
20+ (all ages combined)	177	182.8	0.97	0.83	1.12

Kidney

Age Categories	Observed	Expected	SIR	Lower 95% CI	Upper 95% CI
20-54	9	14.9	0.60	0.28	1.03
55-64	15	18.8	0.80	0.45	1.23
65-74	30	29.0	1.04	0.70	1.43
75+	34	27.0	1.26	0.87	1.71
20+ (all ages combined)	88	89.7	0.98	0.79	1.20

Liver

Age Categories	Observed	Expected	SIR	Lower 95% CI	Upper 95% CI
20-54	2	5.2	0.39	0.04	1.39
55-64	5	7.0	0.71	0.23	1.66
65-74	6	12.3	0.49	0.18	1.06
75+	10	13.6	0.74	0.35	1.35
20+ (all ages combined)	23	38.2	0.60	0.38	0.90

Lung

Age Categories	Observed	Expected	SIR	Lower 95% CI	Upper 95% CI
20-54	57	53.2	1.07	0.81	1.39
55-64	127	118.4	1.07	0.89	1.28
65-74	210	226.7	0.93	0.81	1.06
75+	159	195.0	0.82	0.69	0.95
20+ (all ages combined)	553	593.3	0.93	0.86	1.01

Prostate

Age Categories	Observed	Expected	SIR	Lower 95% CI	Upper 95% CI
20-54	11	51.5	0.21	0.11	0.35
55-64	87	251.5	0.35	0.28	0.42
65-74	212	668.9	0.32	0.28	0.36
75+	209	666.2	0.31	0.27	0.36
20+ (all ages combined)	519	1638.25	0.32	0.29	0.34

Skin

Age Categories	Observed	Expected	SIR	Lower 95% CI	Upper 95% CI
20-54	43	44.1	0.98	0.71	1.28
55-64	25	21.4	1.17	0.75	1.65
65-74	39	26.7	**1.46¶**	1.04	1.95
75+	39	25.4	**1.54¶**	1.09	2.05
20+ (all ages combined)	146	117.6	**1.24¶**	1.05	1.45

Table 1 **Standardized Incidence Ratios using the Montana Population as a Reference, 1979-1999**

Urinary Bladder

Age Categories	Observed	Expected	SIR	Lower 95% CI	Upper 95% CI
20-54	1	11.2	0.09	0.00	0.50
55-64	18	23.6	0.76	0.45	1.21
65-74	90	50.5	**1.78¶**	1.43	2.19
75+	68	61.7	1.10	0.86	1.40
20+ (all ages combined)	177	147.0	**1.20¶**	1.03	1.40

Kidney

Age Categories	Observed	Expected	SIR	Lower 95% CI	Upper 95% CI
20-54	9	12.5	0.72	0.33	1.23
55-64	15	14.9	1.00	0.56	1.56
65-74	30	22.9	1.31	0.88	1.81
75+	34	18.6	**1.83¶**	1.27	2.48
20+ (all ages combined)	88	68.9	**1.28¶**	1.02	1.56

Liver

Age Categories	Observed	Expected	SIR	Lower 95% CI	Upper 95% CI
20-54	2	1.8	1.11	0.12	4.01
55-64	5	2.0	2.50	0.81	5.83
65-74	6	4.9	1.22	0.45	2.67
75+	10	5.9	1.69	0.81	3.12
20+ (all ages combined)	23	14.6	1.58	1.00	2.36

Lung

Age Categories	Observed	Expected	SIR	Lower 95% CI	Upper 95% CI
20-54	57	40.2	**1.42¶**	1.07	1.84
55-64	127	110.6	1.15	0.96	1.37
65-74	210	194.2	1.08	0.94	1.24
75+	159	148.5	1.07	0.91	1.24
20+ (all ages combined)	553	493.5	**1.12¶**	1.03	1.22

Prostate

Age Categories	Observed	Expected	SIR	Lower 95% CI	Upper 95% CI
20-54	11	14.5	0.76	0.38	1.24
55-64	87	91.5	0.95	0.76	1.03
65-74	212	232.3	0.91	0.79	1.04
75+	209	213.5	0.98	0.85	1.12
20+ (all ages combined)	519	551.8	0.94	0.86	1.02

Skin

Age Categories	Observed	Expected	SIR	Lower 95% CI	Upper 95% CI
20-54	43	28.4	**1.51¶**	1.10	1.99
55-64	25	19.8	1.26	0.82	1.79
65-74	39	30.3	1.29	0.92	1.72
75+	39	39.8	0.98	0.70	1.31
20+ (all ages combined)	146	118.3	**1.23¶**	1.04	1.44

exposures early enough to account for cancer latency). However, none of these limitations should consistently bias SIRs towards positive or negative associations.

Another limitation in interpreting the apparent elevation in skin cancer incidence is the demographic difference between Silver Bow County and the U.S. comparison population. Both malignant melanoma and nonmelanoma skin cancers are much more common in white populations. There is a higher percentage of Caucasians in Montana in contrast to the U.S. Therefore, some increase in skin cancer in the Montana population can be expected when compared to the total U.S. population. However, the demographics of Silver Bow County and Montana are fairly similar so this does not explain the elevated SIRs generated through comparisons with state cancer incidence data.

The process for age-adjusting cancer rates in Silver Bow County and Montana were similar as was the time frame for comparison (1979-1999). In comparing Silver Bow County with U.S. rates, there were some discrepancies. The analysis used different time frames of cancer incidence data for Silver Bow County (1979-1999) and the U.S. reference population (1989-1998). Also, there was a difference in the age-adjustment process with the U.S. reference group standardized using the 1970 U.S. population. These discrepancies in age standardization were unavoidable since NCI does not provide the raw data collected through the SEER program.

Even with these limitations and the minor differences in age standardization methods, there appears to be an increase in skin cancer incidence in this area of widespread arsenic contamination. Historically, skin and lung cancer have been the most prevalent cancer outcomes associated with arsenic exposure in the public health literature. Unfortunately no dose estimates were available for this analysis so the slight increase in skin cancer incidence cannot be evaluated against potential arsenic exposure in the area.

Conclusion

The data indicate a slightly elevated incidence of skin cancer in Silver Bow County when compared with age-standardized rates at the State and national level. No other cancer outcomes were consistently elevated when compared with these two reference groups. Because no exposure assessments were included in this ecologic analysis, it is not feasible to directly attribute this increase in skin cancer incidence to soil arsenic contamination in the area.

Recommendations

1. Evaluate melanoma and non-melanoma skin cancer incidence separately since only non-melanoma skin cancers are associated with arsenic exposure.

2. Educate local citizens on ways to reduce or eliminate exposure to ambient arsenic contamination.

3. Educate local physicians on the symptoms, effects, and treatment regimes for arsenic exposure.

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