



Oklahoma State Department of Health
Creating a State of Health

July 6th, 2017

This report is in response to several inquiries to the Oklahoma Central Cancer Registry, Oklahoma State Department of Health in 2016-2017 requesting an investigation into the occurrence of cancer in Bokoshe, Oklahoma. Please do not hesitate to contact us with any further questions or concerns at 405-271-5601 or communications@health.ok.gov

Respectively submitted,

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Summary Report of Cancer Incidence within Bokoshe

Background

The Oklahoma Central Cancer Registry (OCCR) collects information on all reported cases of cancer diagnosed or treated among Oklahoma residents. Currently, there are eighteen years, diagnosis years of 1997 through 2014, of complete data available for analysis. This data can be used to determine if cancer is occurring at an unusually high rate in certain geographical areas throughout the state. This data cannot determine a cause or assess exposure to any substance. The OCCR conducts investigations of suspected cancer clusters upon request.

This report is in response to several inquiries concerning cancer incidence rates in and around Bokoshe due to the disposal of fly ash at a site located just outside of Bokoshe. Bokoshe is located in Le Flore County in eastern Oklahoma and is in the zip code 74930. The concerns were of both the release of fly ash into the air during its transport, as well as the results of leachate into the groundwater and potential subsequent contamination of drinking water sources for the residents.

A cancer cluster is defined as a greater than expected number of cancer cases that occurs within a group of people in a geographic area over a defined period of time. Comparison with the occurrence within the state population or similar community population defines if the occurrence of cancer was greater than expected. In a cancer cluster, cases are the same type of cancer or cancers with the same causes. Often, the cancer types are rare or occur in an uncharacteristic demographic group. Consideration is given to the presence of a specific environmental concern associated with the type of cancer.

Methods

In this analysis, cancer cases diagnosed between 2005 and 2014 were included. There is typically a lag period of years to decades between exposure and cancer development. Therefore, more current years of data may reflect exposures that have occurred over the past decades. The data was split into five year time frames; 2005- 2009 and 2010-2014, to show whether there were time trends among the cancer types of concern.

Standardized Incidence Ratio (SIR) analysis was used to determine if the occurrence of cancer in Le Flore County and the 74930 were statistically higher than the occurrence of cancer in the state of Oklahoma and whether it had changed over time. SIR analysis can determine if the number of observed cancer cases in a particular geographic area is higher or lower than expected, given the population and age distribution for the area of interest. The SIR was obtained by dividing the observed number of cases of cancer by the “expected” number of cases. The expected number was the number of cases that would occur in Le Flore County or 74930 if cancer occurred at the same rate as in the state of Oklahoma (comparison population). The SIR takes into account whether a

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community’s population is older or younger than the comparison population since cancer rates increase strongly with age.

The Fisher exact test was used to calculate the 95% Confidence Intervals (CI) in OpenEpi.¹CI is the range of rates that contains the actual rate 95 times out of 100. The fewer cases the rate is based on, the greater the uncertainty, and therefore the wider the CI. The CI calculated around the SIR are used to determine how likely it is that the number of observed number of cases is high or low by chance. Specifically, if the CI includes 1.0, then the difference between the observed and expected number of cases is likely to have occurred by chance. If the CI does not include 1.0, then the difference between the observed and expected number of cases is not very likely to have occurred by chance.

Results

There are two substances within fly ash that have been identified by multiple agencies as carcinogenic to humans; arsenic and chromium VI. In occupational settings, chromium VI has been shown to result in an increased risk of lung cancer if inhaled. For those exposed to chromium VI in drinking water, there is some evidence of a possible increased risk for mortality from stomach cancer.² Studies have shown evidence that inhalation of arsenic in occupational and some environmental settings may result in an increased risk of developing lung cancer. When individuals are exposed to high concentrations of inorganic arsenic through ingestion, there is evidence that suggests this may increase risk the development of skin cancer, and possibly internal tumors, specifically bladder, kidney, liver, lung and prostate.³

Based on the published evidence, the OCCR reviewed the data for the following cancer types: stomach, lung and bronchus, urinary tract, urinary bladder, kidney and renal pelvis, melanoma, liver, and prostate.

The table below (Table 1.) displays SIR and 95% CIs calculated for the different cancer types at zip code and county level. If the CI includes 1.0, then the difference between the observed and expected number of cases is likely to have occurred by chance. If the CI does not include 1.0, then the difference between the observed and expected number of cases is not very likely to have occurred by chance. The fewer cases the rate is based on, the greater the uncertainty, and therefore the wider the CI.

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Table 1. Standardized incidence ratios (SIR) by cancer type, Le Flore County and Bokoshe Zip Code: 74930, 2005-2014

Cancer type	Le Flore County 2005-2009 SIR (95% CI)	Le Flore County 2010-2014 SIR (95% CI)	74930 2005-2009 SIR (95% CI)	74930 2010-2014 SIR (95% CI)
Stomach	0.91 (0.17-1.50)	0.75 (0.10-1.35)	0.94 (0.12-17.4)	N/A
Lung & Bronchus	1.07 (0.80-1.11)	0.89 (0.63-0.94)	0.95 (0.12-2.86)	1.18 (0.14-4.26)
Urinary Tract	0.82 (0.49-0.90)	0.52 (0.27-0.61)	0.63 (0.02-2.90)	0.44 (0.02-4.09)
Urinary Bladder	0.71 (0.31-0.87)	0.54 (0.63-0.94)	0.08 (0.10-1.46)	0.45 (0.06-8.28)
Kidney & Renal Pelvis	1.00 (0.48-1.19)	0.51 (0.18-0.69)	0.92 (0.04-5.66)	0.46 (0.06-8.56)
Melanoma	0.93 (0.50-1.06)	0.52 (0.23-0.63)	1.57 (0.24-5.46)	1.84 (0.37-8.55)
Liver	0.61 (0.08-1.10)	0.65 (0.12-1.08)	0.80 (0.10-14.73)	N/A
Prostate	0.31 (0.21-0.44)	0.31 (0.20-0.47)	0.24 (0.01-1.36)	0.22 (.01-1.36)

Conclusion

In calculating the SIR and the 95% CIs for both Le Flore and Bokoshe zip code (74930) among cancers associated with both arsenic and chromium VI, it was concluded that the rates are not statistically higher than the state of Oklahoma, and it has not changed over time. The Oklahoma State Department of Health takes inquiries into cancer rates elevation seriously and the OCCR is committed to reassess the data in future years to determine if the incidence of cancer increases over time.

References

1. Dean AG, Sullivan KM, Soe MM. OpenEpi: Open Source Epidemiologic Statistics for Public Health, Version. www.OpenEpi.com, updated 2013/04/06, accessed 2017/05/19.
2. Agency for Toxic Substances and Disease Registry. (2012). *Toxicological Profile for Chromium*. Retrieved from <https://www.atsdr.cdc.gov/ToxProfiles/tp7.pdf>
3. Agency for Toxic Substances and Disease Registry. (2012). *Toxicological Profile for Arsenic*. Retrieved from <https://www.atsdr.cdc.gov/toxprofiles/tp2.pdf>

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