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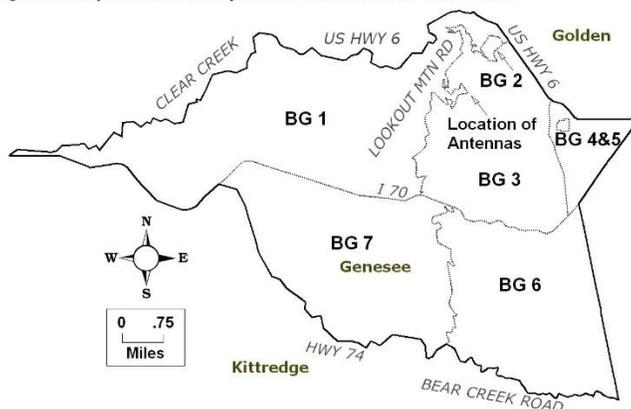
UPDATE: TUMOR INCIDENCE IN RESIDENTS ADJACENT TO THE LOOKOUT MOUNTAIN ANTENNA FARM 1979-2012

GOLDEN, COLORADO

BACKGROUND

This study updates three previous reports of cancer incidence among residents living near the Lookout Mountain broadcast towers that were completed by the Colorado Department of Public Health and Environment (CDPHE) in 1998, 1999 and 2004. The 2015 update evaluates the incidence of a variety of cancers, including brain and other central nervous system (CNS) tumors in census tract 98.10, by including cases diagnosed during 2003-2012, using existing cancer surveillance data available from the Colorado Central Cancer Registry and updated population estimates based on 2010 U.S. Census data. The current update also provides an analysis of radiofrequency (RF) exposure data collected by researchers at Colorado State University (CSU) prior to significant changes in the broadcast antenna tower configuration. These studies were done in response to community concerns about radiofrequency (RF) exposure from the Lookout Mountain broadcast antennas and cancer rates in the Lookout Mountain community. The study area is shown on the map below.

Figure 1. Map of Block Group Areas within Census Tract 98.10



In 1999 and 2004, CDPHE reported a statistically elevated number of brain and other CNS tumors in the two block group areas closest to the Lookout Mountain antenna farm, where residents were likely to have the highest exposure from the towers. The study concluded, however, that the likelihood of a common cause among these cancer cases is weakened because gender and tumor cell type differed between block groups. The current update was designed to address a recommendation from advisory panel members in the 2004 report that any future analysis of cancer statistics should also assess residential RF exposure measurements to the degree possible. A review of the state of the science was also conducted because of the uncertainty regarding a plausible link between RF exposure and cancer at the time the 2004 study was released.

STUDY DESIGN

The 2015 update evaluates cancer statistics reported to the Cancer Registry for individuals living in census tract 98.10 and seven smaller areas, called block group areas, who were diagnosed during the period 1979 to 2012. Age and gender-specific risk ratios (observed/expected ratios) were calculated by dividing the number of diagnosed cases by the expected number of cases for each geographic area for a particular time period. Cancer rates for census tracts in the Denver metropolitan area with incomes similar to those in the study area were used as a standard for comparison, because socioeconomic status (SES) has been shown in the epidemiologic literature to be an important risk factor for brain/CNS cancer.

This study presents an update of all tumor types and age groups evaluated in the three previous studies. Cancers evaluated were leukemia, brain and central nervous system (CNS), non-Hodgkin lymphoma, female breast, eye melanoma, and all cancers combined as well as pineal and pituitary tumors, first assessed in the 2004 study. Benign, in addition to malignant brain and CNS tumors, were investigated for all block groups, because these tumors were the only types of tumors that were consistently elevated in the census tract as a whole, although still within expected statistical variation.

A new addition to the present study is an evaluation of residential location of brain tumor cases in block group 3 compared to RF measurements collected by scientists at CSU during a curbside survey of residences along publicly-accessible streets. Metrics were devised to allow statistical testing of whether brain tumors tended to occur more often at residences with higher RF exposure.

As in past studies, follow-up telephone interviews were conducted with individuals diagnosed with a brain/CNS tumor, or surviving family member, for cases reported as residing in block groups where statistical elevations were observed. The purpose of the interviews was to collect information about an individual's length of residence near the antennas, approximate distance of the home from the antenna towers, whether there was an unobstructed view of the antenna towers from the residence, and occupational history that may have included RF exposure or other work place exposures associated with higher incidence of brain tumors.

FINDINGS

The updated findings from the 2015 study are generally consistent with those reported in the 1999 and 2004 studies. For the period 1979-2012, the number of cancer cases diagnosed in census tract 98.10 compared to the expected number of cases, for each of the different cancer types evaluated, were within expected statistical variation or were statistically lower than expected. The number of cancer cases diagnosed in each of the seven individual block group areas compared to the expected number of cases for each of the different cancer types evaluated was also within expected statistical variation, with the exceptions noted below.

A statistically significant elevation of brain and CNS tumors was observed in residents living in the two geographic areas closest to the towers, that is, block groups 2 and 3, which is consistent with findings from past studies. Numbers of benign brain/CNS tumors in women in block group 2 and numbers of malignant brain/CNS tumors in men in block group 3 remain statistically elevated. Since the 2004 report, there have been two new benign cases diagnosed in women in block group 2 and three additional malignant brain/CNS cases reported in men in block group 3. These additional cases do not meaningfully alter the results or strength of association reported for either of these block groups. One new finding not previously reported was a statistically elevated number of malignant brain cancers in women in block

groups 4 and 5 combined for 1979-2012. Combined block group 4/5 is located approximately 2 miles southeast of the broadcast transmission towers.

Telephone interviews of brain/CNS cases or surviving family members indicated that 100% of block group 2 residences and all but one residence in block group 3 and one in block group 4/5 combined had direct line of sight to the antennas from their residence at the time of diagnosis. RF exposure can be effectively blocked by hillsides, trees or other structures. Therefore, having an unobstructed line of sight to the towers indicates the potential for RF exposure at these residences. Slightly less than half the case residences in block group 3 and more than half the case residences in block group 2 were confirmed to be less than 1 mile from the broadcast towers. Both block group 4/5 case residences for which information was collected reported being more than a mile from the towers, consistent with the fact that all homes in this area are more than a mile away. Spot RF measurements from the Lookout Mountain area taken by CSU scientists confirmed previous data indicating that the intensity of RF exposure is highly dependent on distance from broadcast towers particularly for residences with direct line of sight to the broadcast antennas. Results show a ten-fold increase in RF levels or more for those living less than a mile from the antennas compared to those more than a mile away.

Differences in residency time were reported by those interviewed, with all of the cases from block group 2 having lived at the residence listed at the time of their diagnosis for more than 10 years, while 3 of the 11 cases from block group 3 reported living at that residence for less than 5 years. Only two of seven cases or surviving family members were successfully contacted in block group 4/5, both of whom were reported to have lived near the towers for more than 5 years. The latency, or time between exposure and clinical recognition of a disease, is believed to be at least 5 years and usually more than 10 years for a genotoxic environmental exposure and cancer. In light of the uncertainties related to potential biological mechanisms by which RF might act, however, it is not yet possible to assign a scientifically based estimate of latency for RF exposure and tumor growth. The latest expert reviews of the association of RF exposure from cell phone use and increased risk of brain tumors have not generally detected an association with exposure of under 5-15 years.

Some differences were also reported across block groups regarding past work history. In block group 3, the majority of those diagnosed with a brain or CNS cancer reported having worked in a job category associated in the literature with an increased risk of developing a brain or CNS tumor, although the precise length of occupational exposure associated with increased risk of brain/CNS tumor is unknown, as is the potential for interactive effects with RF exposure in the home. In block group 2, where most cases occurred in women, no occupational exposure associated with an increased risk of brain tumor occurrence was reported. Interview information for the two block group 4/5 cases indicated possible increased risk of brain tumor associated with occupational exposure for one of the cases. The role of occupation as a potential confounder in this study is uncertain but interviews indicate a potentially more significant effect for block group 3 cases.

New results from the current analysis include an evaluation of residential location of brain tumor cases in block group 3 compared to residential RF measurements collected by CSU scientists for that block group through linkage of RF data with available Cancer Registry statistics. The observed/expected calculation approach suggests that residences of brain tumor cases in block group 3 (whether benign and malignant combined or malignant only) had RF values similar to what would be expected from the distribution of RF measurements among the 259 residences not home to any brain tumor cases.

CONCLUSIONS

Results of the 2015 update of cancer incidence from 1979-2012 for residents living in the vicinity of the Lookout Mountain towers are generally consistent with the findings reported in previous CDPHE studies. This study confirmed a persistent elevation in brain/CNS tumor incidence in two block groups (2 and 3) and reports a new finding of a statistically elevated number of brain cancers in one additional block group (4/5 combined). Cancer incidence for all tumor types investigated for census tract 98.10 as a whole and for all other block group areas was within the expected statistical range for both men and women.

The 2015 study provides the first linkage of RF exposure data (external spot measurements) with Cancer Registry data and provides an evaluation of residential location of brain tumor cases in block group 3 compared to residential RF measurements collected by CSU researchers for that block group. Metrics used to assess exposure data for the 2015 study indicate a very low probability of an association between residential RF exposure and brain tumor incidence which weakens the hypothesis that the excess number of brain tumors reported are associated with RF exposure from the broadcast towers. However these results should be considered within the context of the relatively small number of cases reported and availability of exposure data for block group 3 cases only.

This type of epidemiologic study cannot produce conclusive information about cancer causation. Rather, as with past reviews, the goal was to determine if there are data that support an association between the observed elevated risk ratios for brain and CNS tumors and RF exposure from the broadcast towers.

Study findings note inconsistencies in gender, cell type (benign versus malignant brain tumors) and RF exposure level between block groups with statistically high numbers of brain/CNS tumors which weakens the hypothesis of a common etiology or one underlying cause for the elevations reported. Differences were noted in the histologic type for cases residing in block group 2 (benign meningioma) compared to those in block group 3 and combined block group 4/5 (malignant tumors). Recent expert reviews of RF exposure in cell phone users somewhat strengthens the possibility of an association between RF exposure and glioma (malignant brain cancer), but weakens the likelihood of an association with meningioma (benign brain tumors). For the two block groups with elevated numbers of malignant brain tumors (block groups 3 and 4/5 combined) men and women were not similarly affected. There is no indication in the scientific literature that residential exposure to RF would selectively affect one gender differently than another, therefore these findings also argue against a common etiology across block groups. However the scientific knowledge of RF exposure and the potential for interactive effects with other individual exposures or risk factors is still not adequate to draw firm conclusions about this disparity between genders and cell type, particularly for longer-term exposures. One additional inconsistency noted was that block group 4/5 is located distant to the broadcast towers (> 2 miles) compared to block group 3, which indicates likely lower exposure levels for this geographic area as a whole. As with past cancer incidence reviews, it is difficult to draw definitive conclusions from this study because brain cancer is a relatively rare disease and case numbers are few in the Lookout Mountain area.

FOR MORE INFORMATION

A copy of the full technical report may be viewed and printed at:

<http://www.cdphe.state.co.us/dc/envtox/envtoxbom.asp>

GLOSSARY

Confounder – An additional risk factor which may distort the degree of an association between an exposure and disease outcome being studied.

Epidemiology – The study of the distribution and controlling factors of diseases in human populations.

Genotoxic - Causing damage to the DNA or hereditary material of a living cell by physical or chemical agents.

Histology – The microscopic structure, composition and function of human and animal tissues.

Incidence – The occurrence of new cases of disease in a population over a specified period of time.

Malignant tumor – Cancer. Uncontrolled tissue growth that may invade surrounding tissues or spread to distant areas of the body.

Benign tumor – A tumor that is not cancerous. The severity of this condition generally depends on the location of the tumor.

Risk factors – Aspects of personal behavior or life-style, an environmental exposure, or an inborn or inherited characteristic whose presence, based on epidemiological evidence, is associated with an increased likelihood that a disease will develop at a later time.

Statistically significant elevation – An increase in the occurrence of a type or group of cancers that is unlikely to be due to chance or expected variation alone.